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ABSTRACT

Designed for sixth grade students to help them prepare for the Multnomah County (Oregon) Outdoor School experience, the workbook provides fundamental information about soil, water, plant, and animal resources. The workbook begins with an introduction to environmental manners (rules for working in the woods). A section devoted to each resource area provides general information on the specific resource; a glossary of terms and words which students will be expected to know; and learning activities which include charts, matching activities, drawing sheets, labeling and completing study sheets, bingo games, crossword puzzles, word searches, and word scrambles. The activities address the following topics: the water cycle, dissolved oxygen, pH (a measurement scale indicating the acidity or alkalinity of a plant or animal environment), the crayfish, water-loving plants and animals, the soil profile, trees, leaves, vertebrates, insects, reptiles and amphibians, birds, mammals, and the ecosystem. (NQA)

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STUDENT PREPARATION WORKBOOK

For the

MULTNOMAH OUTDOOR SCHOOL

A service of:
Multnomah County Education Service District
Allan J. Thede, Superintendent

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1982 Revision by Rudy Bohm and Wally Cole, Environmental Education Specialists

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This notebook belongs to _____

I am going to _____ Outdoor School

From _____, 19____ to _____, 19____

The relationship of man to the land has undergone many changes. Man has used and converted the natural resources of the land to benefit his life. He has done things that have been bad for the land and bad for himself. Fortunately, he has also done other things which have been good for the land and himself.

If man is to survive on earth, he must learn to live in harmony with the natural resources because he is totally dependent upon them. Past civilizations flourished when they had plenty of natural resources, but vanished when the supply of resources dwindled.

This study of the relationship of the natural resources upon one another and also how man influences and is influenced by the resources, is called "ecology". This term comes to us from two Greek words that mean "the study of the home".

The first step in learning how to live with our resources is to understand each resource. In this book you will learn about each resource, and then when you get to Outdoor School you will see and understand how they all work together.

INTRODUCTION TO ENVIRONMENTAL MANNERS

As you begin your preparation for Outdoor School there are some things you will need to know about studying in the field. By reading the following information carefully you will know what to expect at Outdoor School and what is expected of you.

You will need to learn the meaning of some new words so that you will be able to understand what the resource people will be talking about. Each of the studies of plants, animals, soil, and water has a special language, much as each sport has a special language. In addition, during your field study you will also have the opportunity to study the science of ecology. Ecology is the study of how plants and animals live in their environment and how they interact with each other.

During the time that you are in the field, you will most likely be working in small groups of five or six people. These study groups will be scattered over a very large area of land. Because of this you will need to know some do's and don'ts of working in the woods. These simple rules might be called environmental manners. They are just good common sense and necessary for your protection and for the protection of others working with you. Just as important is the respect that we have for the land and the plant and animal life found there.

Many students have preceeded you at each Outdoor School site; we hope that many will follow. We all have a responsibility to leave the Outdoor School site just as beautiful as we found it.

Study the pictures on the following pages. Circle anything that you think might be harmful to the environment and be prepared to explain your choices.

ENVIRONMENTAL MANNERS

Outdoor School has now completed 16 years of operation with nearly 100,000 sixth graders having participated. Since 1965 we have rented ten youth camps as sites for Outdoor School and have maintained the best of relations with camp owners due to our care of the land and facilities. The continuing availability of the five sites we now use depends on the future care we demonstrate.

Students bound for Outdoor School need to know some basic outdoor manners if they are to help us in maintaining these five sites. Following are four composite pictures showing some people displaying a variety of questionable environmental manners.

We hope you will find these pictures useful in identifying poor environmental manners. A classroom discussion using the pictures (each numbered situation corresponds with the numbered answer below) will help prepare your students for a successful week at Outdoor School and help us conserve these sites for the many students yet to come.

1. Stay on trails and avoid trampling plants. Students should not put hands in pockets for safety reasons.

2. Field study frequently will take place off trails, but short pants are not acceptable because of insects, briars, weather, and comfort.

3. Study groups will always have an adult leader. Students need to follow the leader. Those who run ahead can frequently scare away animals that the whole group would like to study.

4. Trails need to be kept as narrow as possible. Following the leader or single file is the best and safest way to move along a trail. We will not be building fires at Outdoor School, but no one should leave a fire burning or allow a fire to burn unattended.

5. No student should be in the field alone. Outdoor School sites are large and frequently border larger forest, farm, and park lands. Always stay with a study group or within sight or sound of the school buildings.

6. Littering takes many forms, but is never acceptable.

7. Unsupervised picking of native plants is not acceptable at Outdoor School. Plant collection will take place only by study group leaders. We need to remember the many students that will follow; they should be able to see the things we have studied and enjoyed.

8. Again, littering is always unacceptable, but film is particularly bad because the film contains many types of metal salts that are very poisonous to wildlife.

9. Never disrupt groups or individual students who are studying or taking field data. Horse play is never acceptable. Diving in unknown waters can only invite injury and create disruption.

10. Throwing rocks, cones, or any objects is always unnecessary and can be dangerous. It is particularly destructive when wildlife habitats, such as nests and dens, are disrupted.

11. Plants, like animals, are subject to injury and disease. Carving on trees not only defaces and spoils the aesthetics of the forest environment, but can ultimately cause the death of the tree or plant concerned.

12. We all need to be aware of others who are working with us. Our health and safety at Outdoor School depends on our alertness and teamwork. Never let limbs snap; alert others to hazards.

13. In order to observe the wildlife at Outdoor School, we need to keep unnatural noise to a minimum. Unnecessary shouting, running, etc., tends to drive wildlife away or force them/it into concealment.

14. Climbing trees, cliffs, etc., is unnecessary, dangerous, and disruptive to wildlife.

15. We will not be eating in the field, but bottles, cans, plastic, and paper wrappers are all serious pollution problems. Cans and bottles thrown in water not only pollute, but create hazards to swimmers and wildlife.

16. During the spring, students frequently encounter newly born animals, including nests, eggs, and chicks of many birds. When this happens, there is always an exciting learning situation (the teachable moment), but at no time should students disrupt these animals.

17. Students will not have domestic pets at the Outdoor School, but people frequently bring household pets to the outdoor setting. Uncontrolled dogs and cats can be very damaging to many animal populations.

18. Throwing anything, no matter how innocent the situation, can be very unpleasant, particularly when the fall of the thrown object is out of sight.

19. Broken glass and plastic are serious pollution items. Besides causing injury, these materials can and do frequently cause fires by magnification of the sun's rays.

20. Indiscriminate trapping of wild animals could quickly wipe out a population. Trapping of animals at Outdoor School will be supervised by the Resource Specialist and used only for instructional purposes. Students should be discouraged from trapping wild animals at any time without proper supervision.

21. Students should not run at Outdoor School, not only because of the chance of injury, but also the runner will miss seeing and hearing wildlife.

22. Cruelty to animals or other people is not acceptable behavior at Outdoor School.

23. Ripping the bark from trees and stumps and removing moss and ferns from rocks is unnecessary and very degrading to the environment. Such actions deny others a chance to see and enjoy the delicate and beautiful plant and animal communities found there.

24. Walking single file on trails is the best way to move about in the forest, but care needs to be taken to keep a reasonable space between individuals to prevent stumbling and tripping others. Moving as quietly as possible provides the maximum number of teachable moments.

25. Cutting across trail bends or hillside switchbacks destroys vegetation, accelerates erosion, and generally degrades the forest community.

26. Students do not bring radios to Outdoor School. In any outdoor setting loud radios and tape recorders frighten animals, are disruptive to others, and infringe on the rights of those who come to the forest to hear the sounds of the natural environment.

    Walking sticks are not a good idea as they are often used to thoughtlessly whack at trailside foliage instead of for support.

27. Many of our most beautiful wild flowers and other interesting plants are disappearing because they have been removed from their forest environment by people who wish to have them in their yards. Few of these plants survive and everyone loses because of the mistakes of a few.

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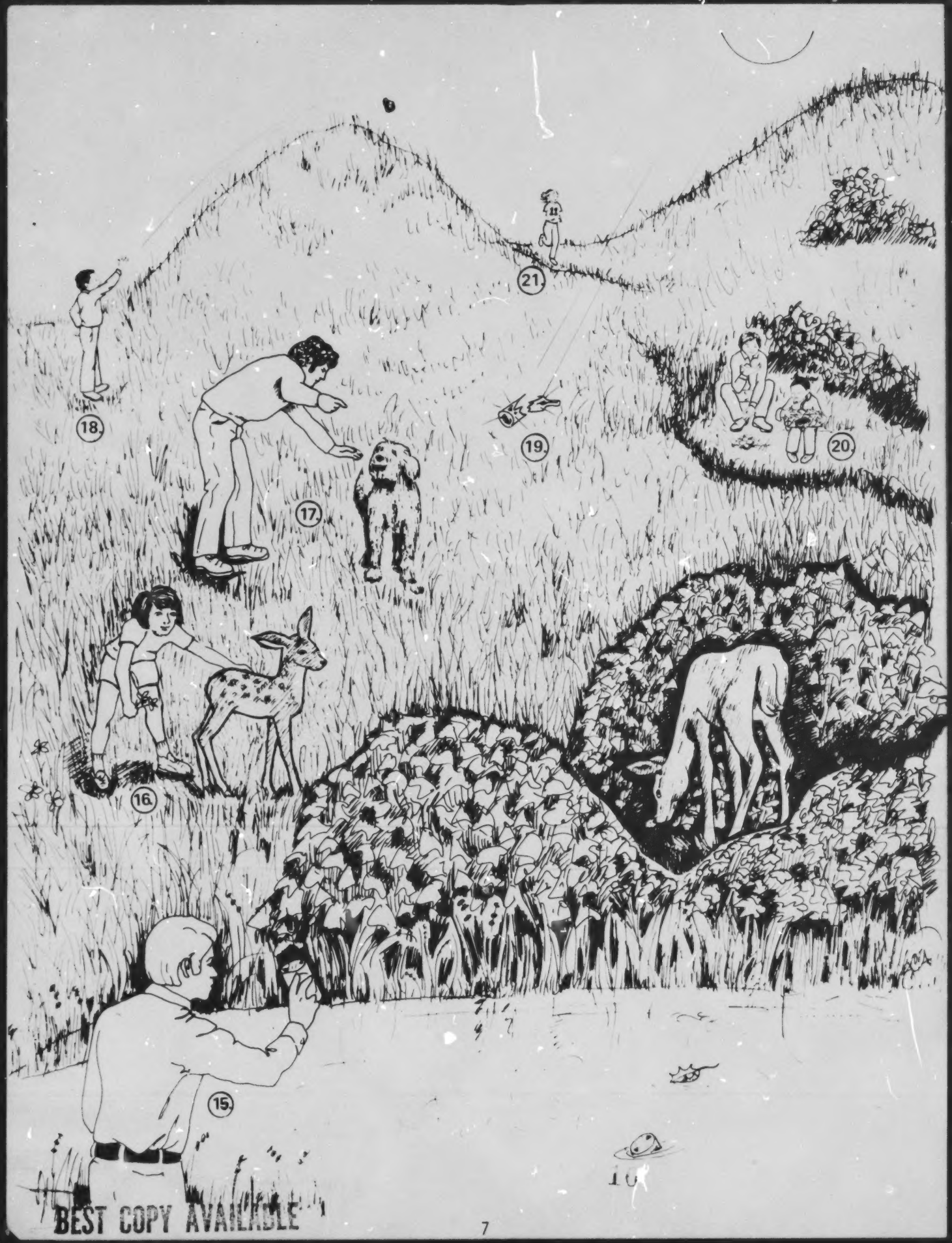

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A GLOSSARY OF WATER WORDS

AMPHIBIAN	Means "living in two places". These animals hatch from eggs which have been deposited in ponds or streams. They live in the water like fish when they are young. Gradually they grow lungs and legs, breathe air and live on land.
ANADROMOUS FISH	Those fish which spend the greater part of their lives in salt water, but migrate into fresh-water streams for reproduction.
AQUATIC	Living or growing in water.
AQUATIC ROOTS	Roots that are in the water. They are generally small and lack root hairs.
ARTESIAN WELL	A deep well in which water rises by subsurface (under the ground) pressure.
CAPILLARY WATER	Water held in the fine spaces around soil particles. This water can be used by plants.
CONDENSATION	The process by which water vapor changes to liquid water, usually minute water droplets forming clouds.
CRUSTACEAN	Animals living usually in water, having gills, two long antennae, jointed legs, claws, and having a fused head and thorax.
CUBIC FEET PER SECOND	A measurement we use to find out how much water is flowing past a certain point every second. A water flow of one cubic foot per second would be about 449 gallons every minute.
CUBIC FOOT OF WATER	The water in a container that is one foot wide, one foot deep and one foot long. One cubic foot of water is about 7½ gallons and weighs 62.4 pounds.
DELTA	The accumulated sediment at the mouth of a stream.
DISSOLVED OXYGEN	The useable oxygen dissolved in the water. It is measured in "parts per million" and is essential to aquatic life. (P.P.M.)
DROUGHT	Unusually long periods of dry weather.
EROSION	The washing away or wearing away of the land surface. Flowing water often makes gullies in the soil.
EUTROPHICATION	Enrichment of water with nutrients which leads to an increase in plant and animal growth. Over a period of time decomposition of this matter causes low dissolved oxygen.
EVAPORATION	The changing of water into vapor...from a liquid to a gas.
GRAVITIONAL WATER	Water that moves downward into the zone of ground water. Water stored in underground streams, caverns, and the air spaces in the soil.

GROUND WATER	Water that collects in the ground, concentrating at and below the water table.
HARD WATER	Water containing certain mineral salts which combine with soap and prevent suds from forming.
HYDROSCOPIC WATER	Water which forms a thin film around soil particles. This water cannot be used by plants.
pH	A measure of the concentration of hydrogen ions. It tells us whether the water is acid or alkaline.
POLLUTION	Caused by dumping wastes into our water. These wastes may cause water to be unuseable.
PRECIPITATION	Moisture falling from clouds or separating from the air such as rain, snow, sleet, hail, frost, fog, or dew.
RESERVOIR	A place where water is collected and stored for use, usually related to a man-made structure such as a pond or lake behind a dam.
RIFFLE	A shallow area in a stream that causes the water flowing over it to become broken and uneven in flow.
RUNOFF	Excess water which the ground cannot absorb and which runs off the surface of the ground to enter the drainage system, streams, and rivers.
SEDIMENT	Any material carried in suspension in water which will settle out as the speed of the waterflow lessens.
SOFT WATER	Water relatively free of minerals.
SPRING	Formed by ground water coming to the surface on top of an impervious layer.
SURFACE WATER	Runoff and also where the water table emerges at the surface of the ground in lakes and streams.
SWAMP	An area of low ground, saturated with water over a long period.
TOXIC	Poisonous. In water it is usually associated with a waste which kills fish and other aquatic life.
TRANSPIRATION	The process by which plants release water into the air from their leaves and other surfaces. This loss is by evaporation.
WASTES	Sewage, water from industrial processes, return irrigation water, or any other water which has been used by man and changed in the process.
WATERSHED	Any area of land which drains into a particular stream of other bodies of water. A drainage basin.
WATER TABLE	The height at which free water occurs in the soil profile, and as surface water in streams and lakes

A STUDY OF WATER

GENERAL INFORMATION

Water is our most valuable renewable resource. Every form of life needs it to survive. Man finds far more uses of water than any other animal on earth. We need water for industry, irrigation, recreation, transportation, drinking, and many other home uses. Water is so important to us that many of our cities and industries have been built next to large rivers, lakes, or the ocean. We have built large dams to store the energy of flowing rivers to provide electric power and water for irrigation in dry farming areas.

The freezing and thawing of water helps break rocks into smaller particles that eventually become soil. Water transports soil from higher ground and deposits it at lower levels. These alluvial (water borne) soils form the rich soils of our river valleys and deltas. Water helps take nutrients down into the soil so plant roots can use them. Water in the soil is used by plants to manufacture food. Animals also need water to live.

Where does all of our water come from? Actually, there are many sources of water. Among these are:

1) Evaporation from oceans, lakes, rivers, and snow masses.
2) Transpiration from the plants that cover much of the earth.
3) Evaporation from land areas that contain moisture.

As the sun warms the earth, evaporation takes place, much like a tea kettle producing steam that disappears as water vapor into the air. Warm air will accept and hold more water vapor than cold. Warm air rises, carrying with it water vapor. As the warm air rises to an altitude with less air pressure, it expands and cools. This water vapor may condense (become visible) in the form of clouds. If the condensation continues and the water droplets combine to form larger drops, rain will fall. If the condensed water vapor becomes super-cooled it may freeze into ice crystals. These tiny ice crystals may grow into snowflakes, and as they gain weight, fall out of the clouds. If the air is cold all the way to the ground, precipitation occurs as snow. If the snowflakes fall through warm air and melt, then fall through cold and freeze again, we have sleet. We have hail during thunderstorms when the snowflakes or drops of water are carried back up into the freezing cloud by the violent winds that occur during thunderstorms. They freeze, fall, partially melt, and are carried back up again and again until hailstones are formed which are so heavy that the updraft can no longer carry them back into the cloud. Some hailstones may reach the ground as large as softballs. Here on the west coast, evaporated water comes to us from the North Pacific Ocean. On the other side of the Rocky Mountains, most of the oceanic water vapor is carried north from the Caribbean Sea and the Gulf of Mexico.

In one of these forms of precipitation (rain, freezing rain, sleet, snow, hail, etc.) water will reach the ground. Some of this water soaks into the ground, some evaporates immediately, and the rest flows over the land's surface into streams, lakes, and into the ocean. This water is called runoff. The cycle from the air to the land and back to the air again has no beginning or end, and is known as the "water cycle". Some rainfall sinks into the soil as gravitational water and becomes our underground water supply. It is stored in the spaces between particles of soil and rocks. Actually, under our country and buried in our soil lies a vast underground reservoir of fresh water that is known as ground water. This underground reservoir has a surface that is called the water table below which the water is more concentrated. When the

water table comes to the surface, springs, streams, and lakes occur, and the water there is known as surface water. When we dig a hole from the top of the ground down to below the water table, we create a well. The deeper the hole, the more water from the surrounding area flows into it....until we reach the impervious bedrock. Excess water that drains from the surface as well as underground down to the ocean, is also called runoff! Other ground water may be taken up through plant roots to supply them with food from the soil. This water that the plants can use is called capillary water. The third kind of ground water is called hydroscopic water. It forms such a thin film around soil particles that it is impossible for the plants to take it up in their roots. The soil is the greatest reservoir or storage place for natural fresh water supply. Snow pack in the mountains is the next largest storage place, followed by natural lakes, man-made lakes and ponds.

The difference in the plants and animals that live on land and those in the water, is that the life forms found in water are able to survive with very little oxygen. The oxygen is dissolved in the water and it is difficult to separate the two. Water is such a heavy substance that aquatic plants and animals depend on it for buoyancy and ease of movement. (For example, have you ever noticed how easy it is to lift objects or raise your arms and legs under water?) Land animals, however, have had to develop stronger muscles for support.

More water is used in agriculture than in any other industry. Much of this is used for irrigation, but natural rainfall provides water for many of our crops. Some of the water that plants use is lost through a process called transpiration. Transpiration is the loss of water from leaves, stems, and needles through evaporation. Transpiration in plants, which is like perspiration in people, causes plants to lose huge amounts of water. For example, a corn field can lose up to 1,296 tons of water per acre every year!

Although the water cycle really has no beginning or end, the source of our water on land here in the Pacific Northwest is from precipitation in its many forms. Students attending Outdoor School should be familiar with the prevailing climate here in western Oregon, so that they can more fully understand the significance of the water cycle, the concept of watershed, and the plant and animal communities that exist here.

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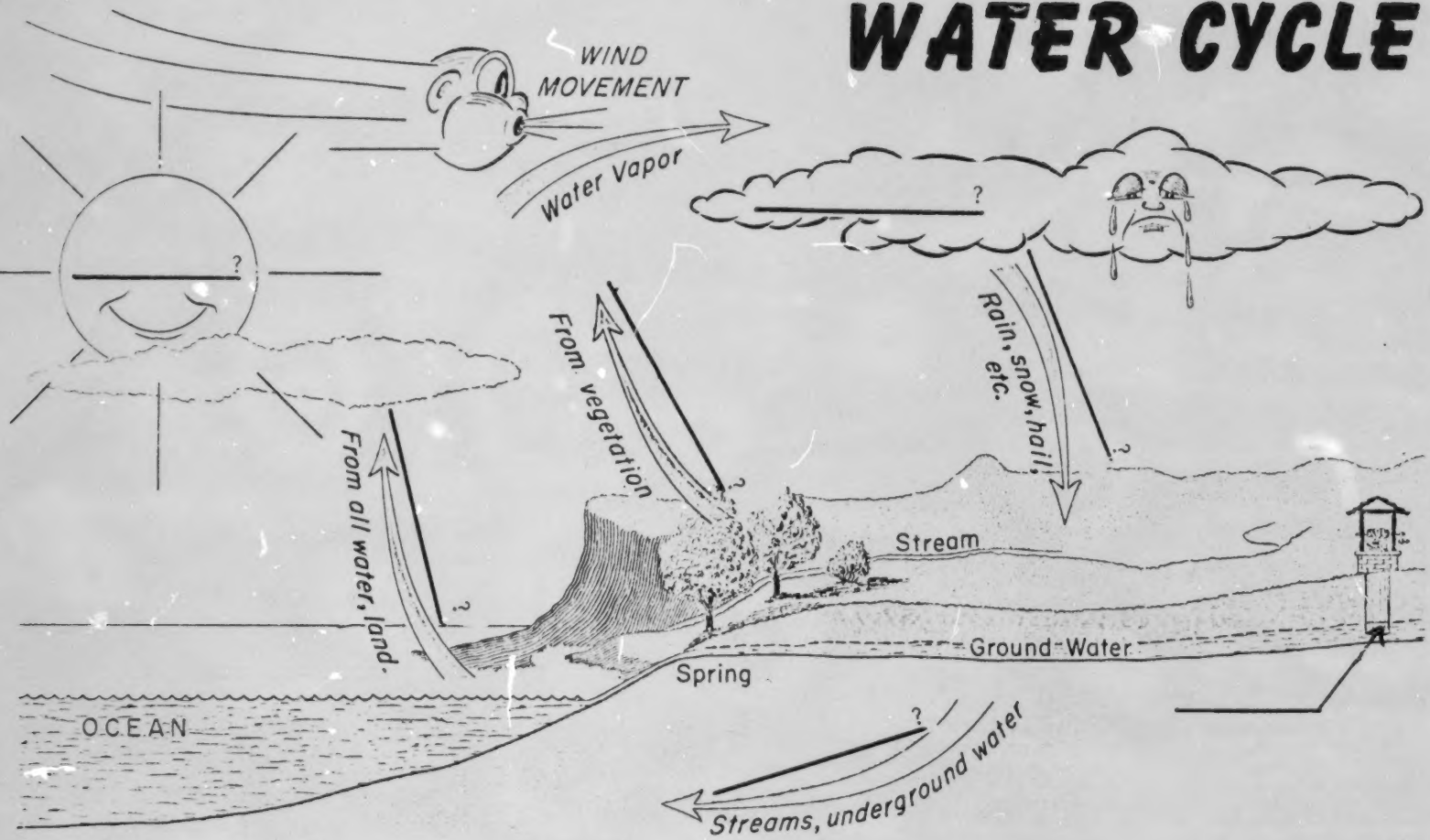
WATER CYCLE



WATER COMES AND GOES FROM EARTH TO SKY IN AN ENDLESS CYCLE

PLACE THE PROPER TERMS IN THE APPROPRIATE SPACES PROVIDED

1. Transpiration 2. Runoff 3. Man-made well 4. Evaporation
5. Condensation 6. Precipitation 7. Sun

WATER WIZARDRY

WATER AND YOU

A. List five ways in which you use water at home.

1. _____ 4. _____
2. _____ 5. _____
3. _____ _____

B. List five recreational activities that occur near or in water.

1. _____ 4. _____
2. _____ 5. _____
3. _____ _____

C. Name one way in which industry uses water.

1. _____
_____

D. What use of water is the Pacific Northwest especially dependent upon?

_____
_____
_____

E. How many gallons of water does the average U.S. citizen use at home each day?
_____ gallons per day

WATERSHED

A. What is a watershed and how does it work?

_____
_____
_____
_____
_____

B. Study the map on Pages 17-18. The name of the creek or river your Outdoor School site is on is _____. Can you outline on the map its watershed? The next largest creek or river your watershed drains into is _____. Can you outline its watershed? Continue this process until you reach the Pacific Ocean. Notice that the first watershed becomes part of the second, the second the third, etc. What watershed does the rain fall into on the other side of the Cascade Crest?
_____

WATER WIZARDRY (Continued)

C. The watershed that Portland's domestic water comes from is the _____ _____ watershed. What is a reservoir? _____
How many reservoirs do you see in the watershed? _____ How many times per month are water quality tests made here? _____

TYPES OF PRECIPITATION

A. What is Oregon's most common form of precipitation? _____

B. What is it called when raindrops freeze before hitting the ground? _____

C. What is it called when water vapor freezes before it turns into droplets? _____

D. What is it called when water vapor turns into droplets before it rises into the air from off the ground? _____

E. What is it called when water vapor freezes at the ground level? _____

F. What is it called when a cloud forms close to the ground? _____

G. During a thunderstorm, snowflakes or raindrops are carried up into freezing clouds by strong winds. Up in the cloud they freeze, fall, are carried back up by the wind, freeze, fall, etc. etc. In the process, they become larger and larger until they are too heavy for the wind to carry. They finally fall to the earth.

What form of precipitation is this? (Hint: They can get as big as softballs.) _____

WATER STORAGE

A. Sometimes we have too much water on the ground and it is called a _____.

B. Sometimes we have too little water over a long period of time and it is called a _____.

C. How does man try to control water storage to prevent the above?

1. _____ 3. _____

2. _____ 4. _____

D. How does nature store water?

1. _____ 4. _____

2. _____ 5. _____

3. _____ 6. _____

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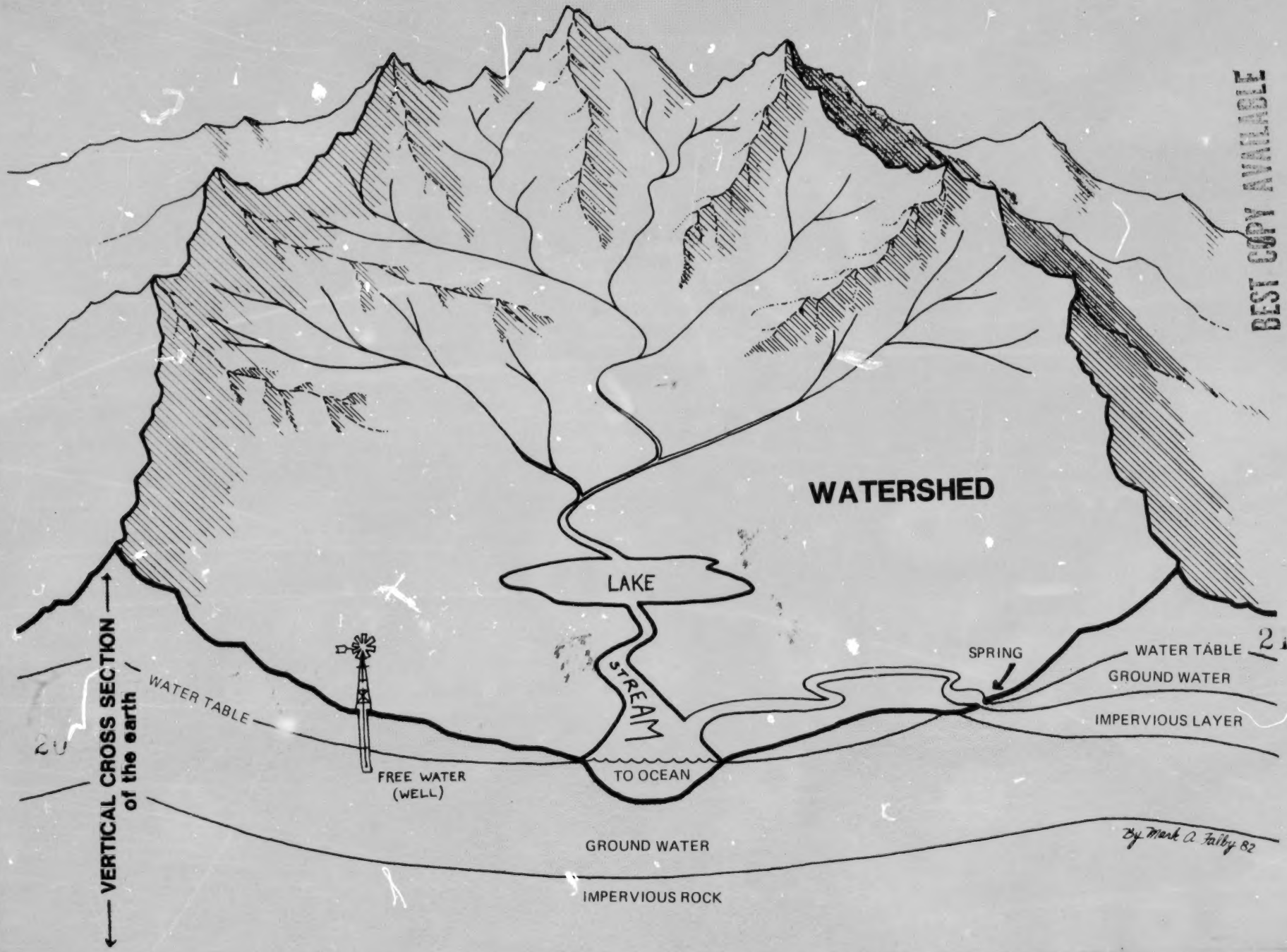

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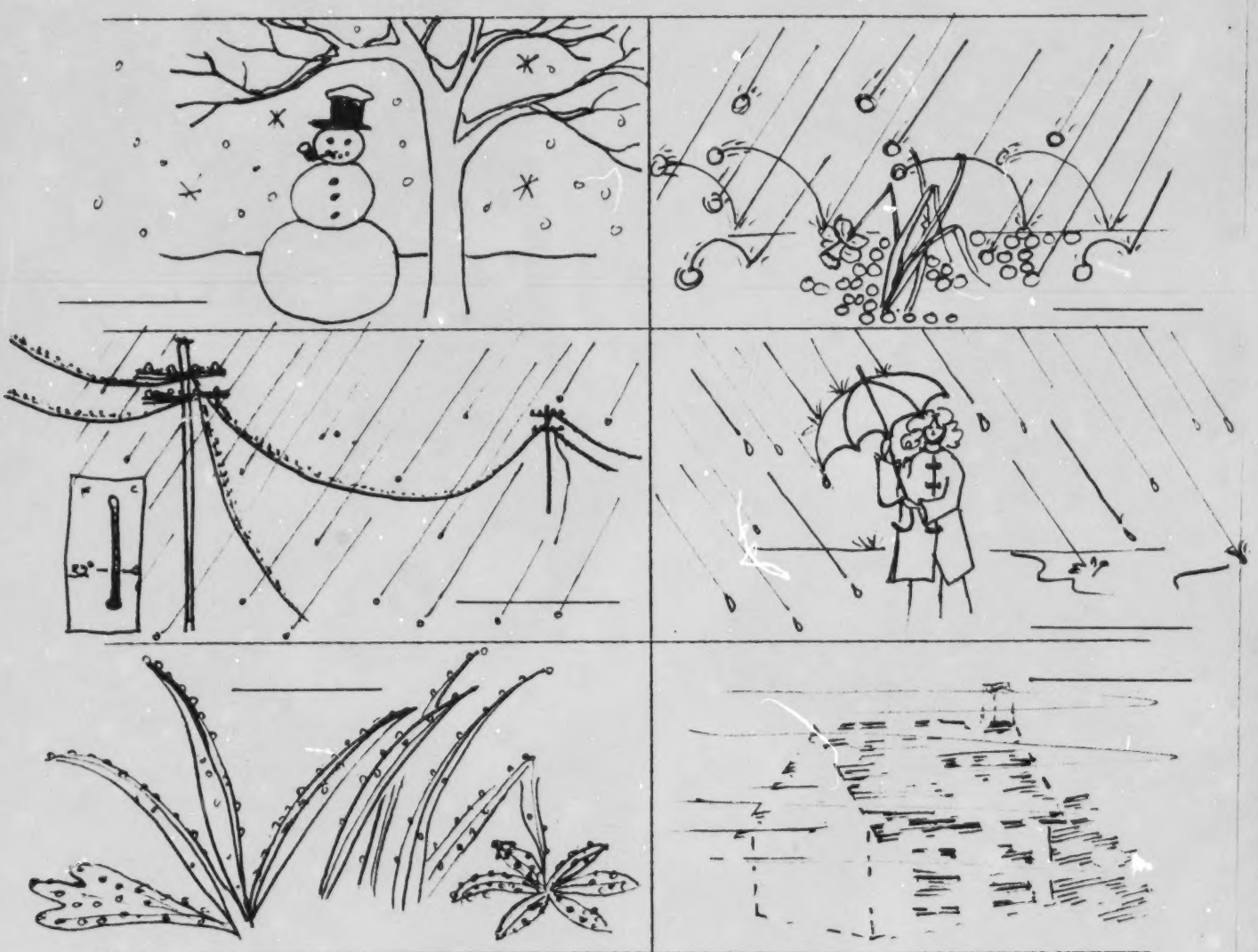
MIX AND MATCH

LABEL EACH FORM OF PRECIPITATION

Here are the possibilities:

Dew	Fog
Snow	Hail
Rain	Sleet (Freezing Rain)



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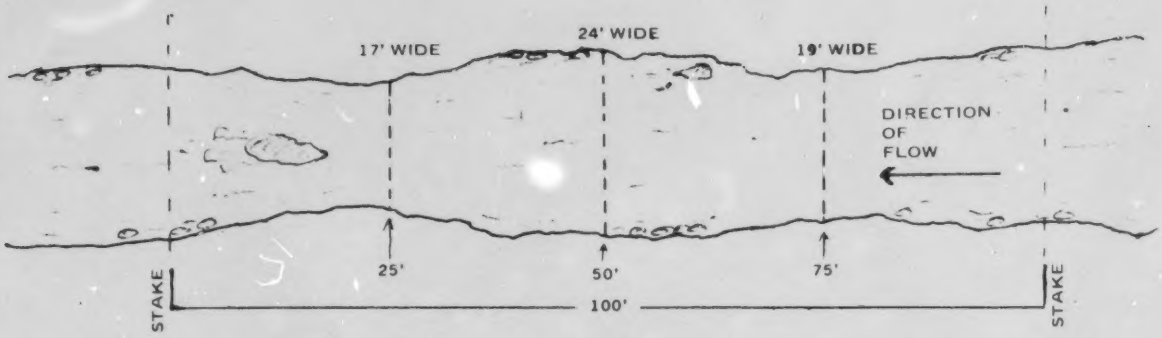
WATER MATH PROBLEMS



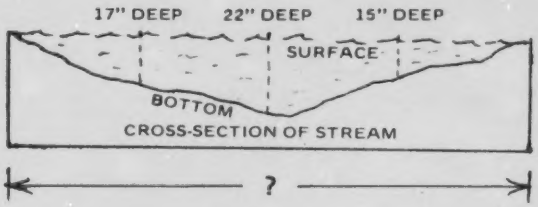
1. Width Of A Stream

The stream at your Outdoor School is wider in some places than others. To find the average width you measure the width at three different places and find distances of 19 feet, 24 feet, and 17 feet. To find the average width you use the following formula:

_____	+	_____	+	_____	=	_____	÷ 3 =	_____
First Measurement		Second Measurement		Third Measurement				Average Width

Another stream you measure has widths of 10 feet 2 inches, 8 feet 6 inches, and 11 feet 4 inches. The average width is _____. (Try converting all measurements to inches first, then divide the total by 12.)

2. Depth Of A Stream



You wade straight across the stream and measure the depth at three places, equal distance apart. You will find it 17 inches deep toward one side, 22 inches in the middle, and 15 inches toward the other side. Using the same formula you find the average depth is _____. In a boat you measure straight across a larger stream at three equally spaced locations and find depths of 5 feet 7 inches, 6 feet 1 inch, and 3 feet 4 inches. The average depth is _____.

3. Feet-Per-Second Flow

You measure 100 feet along the stream and place a stake at each end. You toss a twig in the middle of the stream at the upstream stake and, using a stopwatch, find it takes 50 seconds for the twig to float 100 feet downstream past the other stake. To find the foot-per-second flow of the stream use this formula:

_____	÷	_____	=	_____
Distance		Time		Foot-Per-Second Flow

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4. Cubic Feet-Per-Second

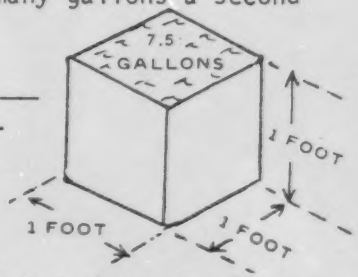
Engineers measure water volume in cubic feet (as if you had a container 1 foot x 1 foot x 1 foot). To tell how many cubic feet-per-second this stream carries, use this formula:

_____	x	_____	x	_____	=	_____
Average Width In Feet		Average Depth In Feet		Feet-Per-Second Flow		Cubic Feet-Per-Second Flow

5. Gallons Per-Second

Each cubic foot contains 7½ or 7.5 gallons. To find how many gallons a second that flows past your stakes use:

_____	x	_____	=	_____
Cubic Feet-Per-Second		Gallons Per-Cubic Foot		Gallons Per-Second



6. Gallons Per-Day

To find how many gallons our stream carries in a day, remember there are 60 seconds in a minute, 60 minutes in an hour, and 24 hours in a day. Using the formula:

_____	x	_____	x	_____	=	_____
Seconds In A Minute		Minutes In An Hour		Hours In A Day		Seconds In A Day

Then it is just a matter of multiplying the seconds x the gallons per-second

_____	x	_____	=	_____
Seconds In A Day		Gallons Per-Second		Gallons Per-Day

7. People Supplied Water Per-Day

Americans use an average of 75 gallons of pure water for their own home (domestic) use every day. Use this formula:

_____	÷	_____	=	_____
Gallons Per-Day Of Your Stream		Gallons Per-Day Use Of Average American		Number People Your Stream Would Serve Per-Day

If we include manufacturing and food production we find that the average American uses 1,500 gallons a day. How many people would your stream serve now? BUT how much of our water is polluted.....is needed for wildlife.....is in the wrong place to be used.....is needed for inland navigation???

DISSOLVED OXYGEN IN WATER

The amount of usable oxygen (that is, the oxygen that the plants and animals in the water use to live) in the water is called dissolved oxygen (DO). It is measured in parts per million which is shorted to ppm. For example, if we found that the water had 8 ppm of dissolved oxygen, it would mean that in one million gallons of water, there would be 8 gallons of oxygen.

All life, both plant and animal, needs oxygen to live. Water gains oxygen from:

1. rain (snow) falling through the air or splashing onto a water surface;
2. falling over waterfalls or riffles in streams;
3. wind-caused wave action or lakes and oceans;
4. aquatic plants giving off oxygen in the daytime.

During daylight all plants, both land and aquatic, use carbon dioxide (CO_2) and give off oxygen (O_2) in the photosynthetic process (manufacturing food). At night the reverse is true. Since there is no light, photosynthesis stops and plants use oxygen and give off CO_2. Over a 24-hour period a plant gives off more oxygen than it uses at night because the plant processes are slowed....a lucky event for us air-breathing humans!!! Plants growing in water do the same thing and overall produce more oxygen than they use. Still water with large amounts of plant growth will fluctuate the most in amounts of dissolved oxygen during 24 hours. There is a limit to the total amount of oxygen water can hold, depending on air pressure and temperature. At normal air pressure and at 50°F (11°C) 15 ppm is the most DO water can hold. This condition is called saturation.

Some species of animal life in water (salmon, trout, crayfish) can survive when the dissolved oxygen is as low as 5 ppm; some other forms can survive down to 4 ppm; a few unusual ones (catfish and carp) can survive in 2 or 3 ppm. Below that animal life disappears.

The dissolved oxygen in water can be reduced in several ways. Dead and decomposing plants and animals in water can use up more oxygen than produced when aerobic (air using) bacteria feed and multiply on the dead material. The more bacteria, the more oxygen used! Warm water will hold less oxygen than cold water. When the sun shines on reservoirs behind dams on rivers, the DO drops lower than that in the free flowing river (heat pollution). This has happened on the Columbia and other rivers, which we have dammed for electric power production. This has had a serious effect on salmon runs. Industrial heat discharged into rivers can cause heat pollution. Too many animals using dissolved oxygen in a body of water can lower the oxygen amounts....eventually causing the death of the animals. Toxic compounds from factories can kill plant life, reduce photosynthesis and therefore reduce the amount of oxygen. Certain kinds of pollution from industry such as wood sugar from pulp mills can feed oxygen requiring bacteria and they can multiply until they use up the oxygen. This used to be a condition in the Willamette River before laws were passed controlling water quality.

DISSOLVED OXYGEN QUESTIONS

1. What is dissolved oxygen (DO)?

   a. _____

2. How is it measured?

   a. _____

3. Plants or animals cannot live in water with less than _____ ppm of DO to live.

4. Salmon, trout, and crayfish need at least _____ ppm of DO to live.

5. Under normal conditions dissolved oxygen saturation is reached at _____ ppm.

6. What kind of things tend to <u>reduce</u> the amount of dissolved oxygen in water?

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

7. What kind of things tend to <u>increase</u> dissolved oxygen in water?

   a. _____

   b. _____

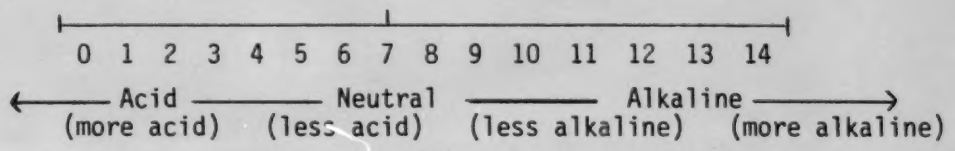
   c. _____

   d. _____

DESCRIPTION OF pH

pH is a scale of measurement to indicate how acid (sour) or how alkaline (sweet) a plant or animal environment is. Aquatic biologists and soil scientists have developed test kits to give them this information. You will use such test kits at the Outdoor School to study plant and animal environment.

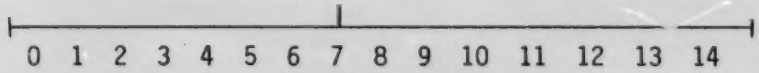
pH is measured in a scale of from 0 (very acid) to 14 (very alkaline) with the midway point (7) being neutral, or neither acid or alkaline (sour or sweet).



To find pH, you will test a small sample of water or soil. When you finish the test, you will have arrived at a number. If the number is between 0 and 7, the water or soil is acid; if it is between 7 and 14, it is alkaline; if it is 7, it is neutral. It is more acid or more alkaline the further the number appears from "neutral" (7) on the scale. You can test the pH of other things besides water and soil. On the pH scale below, you can see the pH reading of some common things that you might find in your home.

More Alkali
14.....Pure Alkali (base)
13.....
12.....Baking Soda
11.....
10.....
9.....Soap
8.....
Neutral
7.....Pure Water, Blood
6.....
More Acid
5.....Sour Milk
4.....Orange Juice
3.....Lemon Juice, Vinegar
2.....
1.....Pure Acid

pH RANGES THAT SUPPORT AQUATIC (WATER) ANIMAL AND PLANT LIFE



6.5 ↔7.5 (Largest variety of animals, trout, mayfly, stonefly, caddisfly)
7.0 ↔9.0 (Snails, Clams)
6.5 ↔8.5 (Bass, Crappie)
6.0 ↔9.0 (Carp, Suckers, Catfish, Some insects)
6.5 ↔12.0 (Plants (algae, rooted, etc.)
1.0 ↔13.0 (Bacteria)

AN AQUATIC ANIMAL - THE CRAYFISH

One of the most interesting crustaceans found in Oregon is called the "crayfish", "crawfish', or "crawdad". These interesting creatures can be found living on the bottom of almost any fresh water lake or stream. Their principle food is aquatic plants, but they will also eat animals. Animals that eat both plants and other animals are called omnivores. Since crayfish will also eat dead animal and plant material, they can also be called scavengers. Crayfish are most active at night to avoid predation by such animals as large fish, raccoons, or man. Crayfish are predators, too. How?

The crayfish has a hard reddish-brown exoskeleton (skeleton on the outside of its body), which covers the entire body and helps protect it from other animals. At the joints the exoskeleton is thin and soft to permit movement. The crayfish can move in all directions on four pairs of stick-like legs. The two larger front "arms" are tipped with oversized claws used for defense and for tearing and holding food. When the crayfish is alarmed it can propel itself quickly backwards through the water by flipping its tail underneath its body in successive jerks. The crayfish has gills which enable it to live its life under water. However, it can live out of water for short periods of time if the gills remain wet. On the other hand, if a crayfish were kept in a bucket of water, it would soon use up the dissolved oxygen in that water. Unless it could climb out of the bucket, or fresh water (with DO) were added, the crayfish would die.

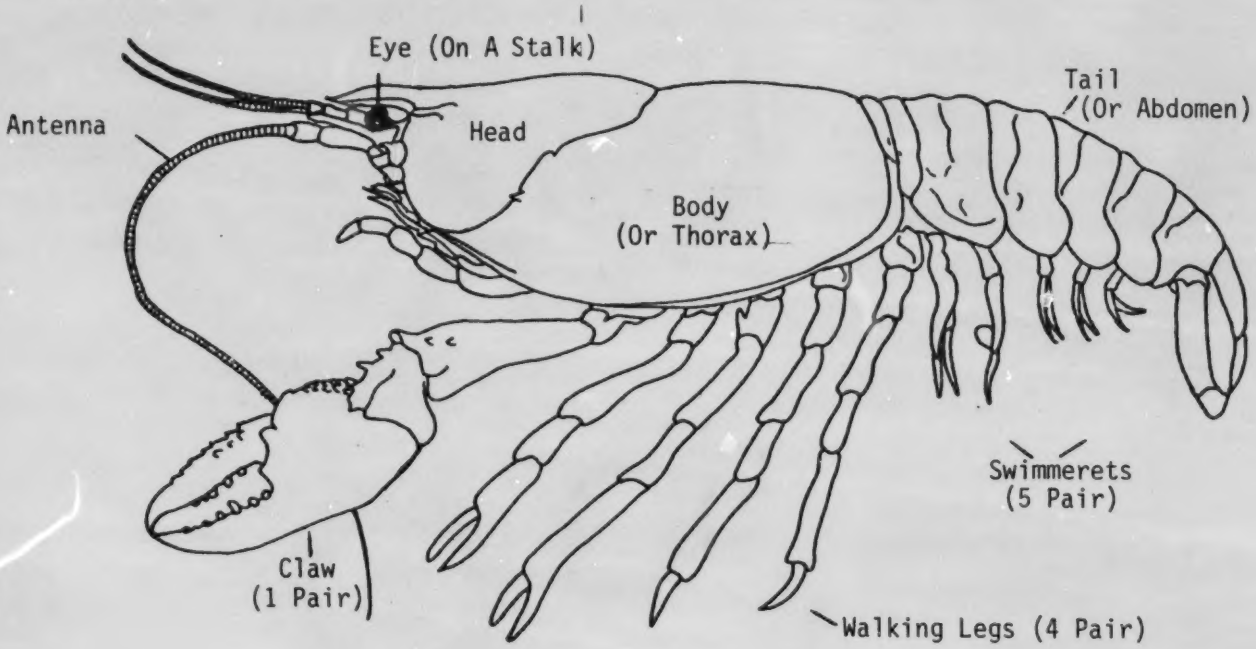
Reproduction in crayfish is unique....the female attaches her eggs with a sticky jelly-like substance under her tail where they hang like berries and are aerated by movement of fan-like swimmerets under the tail. Depending on the temperature, it takes five or more weeks for the eggs to hatch. Each young is a minature crayfish and is about the size of a pencil point when hatched. Like most shellfish, the crayfish must molt, or crawl out of its rigid outer shell in order to grow. After molting, new shell material is oozed out of its body, taking about five days to harden to supply a larger "home" for its body. During this time, the crayfish is soft and vulnerable. Adult crayfish may grow to seven or eight inches long, requiring dozens of molts.

The crayfish has the ability to replace lost parts of its body such as a claw, a leg, or an eye. This ability of regeneration is greater in the young animals than in older ones. Upon loss or removal of an appendage, the new one is partly formed at the next molt, then increases in size with successive molts until restored.

Crayfish are important in that they help clean up the dead animals on stream and lake bottoms. They are also indicators of water quality. Crayfish cannot live in water with low amounts of oxygen or much pollution. The meat of the crayfish is delicious and can be boiled and eaten. Another member of the crayfish family that lives in salt water is the lobster.

THE CRAYFISH

The stream you will be observing on water study may be the habitat for the crayfish pictured below. By studying the animal's parts and answering the questions you may find out where to look for the crayfish, what it eats, and the niche it fills in its habitat.



1. What purpose do you think the antenna have, especially at night and in muddy water?

   _____

2. What animals might eat crayfish? _____

3. How would the crayfish use its big claws? _____

4. What purpose do the small claws on the walking legs serve in a fast-flowing stream?

   _____

5. In which direction would the crayfish move if alarmed? Indicate on your drawing:

6. During molt the crayfish is open to predation. What do you think he does during this time? _____ Where? _____

7. Why is the crayfish more active at night? _____

8. How might a crayfish lose a leg? _____

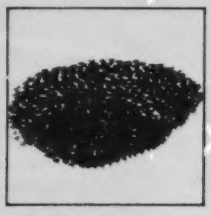
9. His salt water cousin is called a _____

WATER IS A HABITAT FOR WATER-LOVING PLANTS AND ANIMALS

PLANTS

Cattail Along the edges of ponds with its roots in water-saturated soil

Skunk Cabbage In swampy areas with its feet in the water

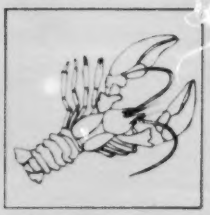


Duckweed Tiny plants that float on pond water with small roots hanging down

Water Lily In ponds with roots fastened to the bottom and leaves and flowers on the surface

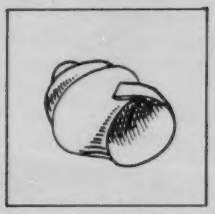
Coontail In ponds growing on the bottom and remaining entirely submerged

ANIMALS



Crayfish Lives in water, gets oxygen from water through gills—has skeleton outside (exoskeleton)—eats plant and animal material—hides during days—limited mobility by crawling—quick escape mobility by flipping tail (backwards)

Fish Lives in water—gets oxygen from water through gills—eats animal material—highly mobile—swims to escape enemies



Snail Lives in water—gets oxygen from surface (some) or through gills (some)—eats plant material—low mobility on bottom and on plants (snail's pace)—hides in hard spiral shell

Clam Lives on or in the bottom of stream or pond—breathes and eats through a siphon by pumping water in one and pumping wastes out another—stationary—closes shell for protection

Water Strider Lives on the water surface (surface tension) and kicks swiftly along surface to escape enemies—catches other insects for food (predator)

Water Boatman Lives and feeds in the water but comes to surface for oxygen—eats algae or animal material sucked from the ooze on the bottom—fast swimmer swimmer to escape enemies

Frog Lives on land and water (amphibian)—eggs laid in water—tadpoles swim in water and breathe through gills—adults emerge to land and breathe through lungs

Dragonfly Adults fly but deposit eggs in water where nymphs hatch and breathe through gills but emerge onto plants to hunt prey (predator)

Duck Food consists mostly of aquatic plants, insects, and other animal material from an aquatic environment.

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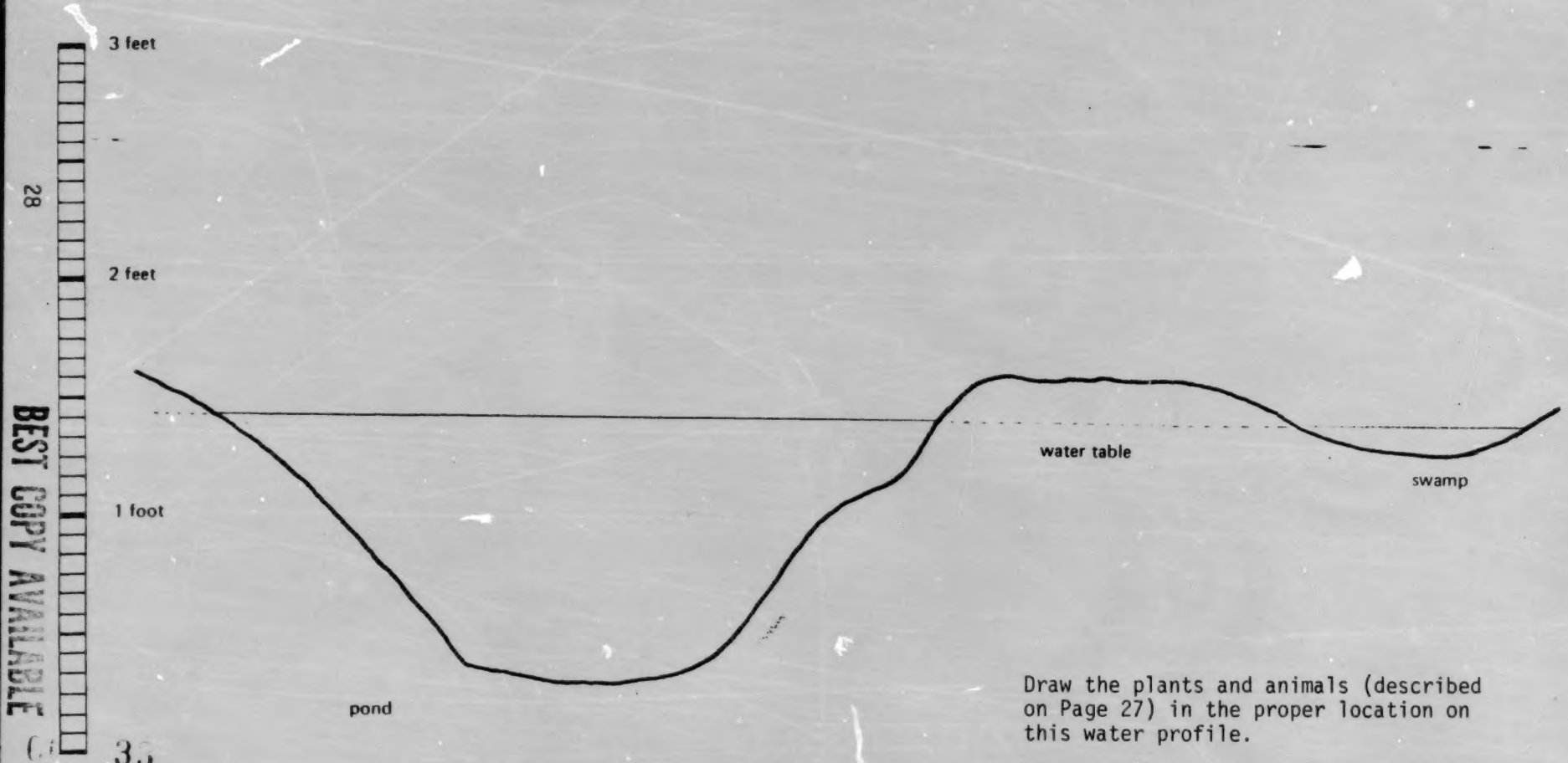
WATER IS A HABITAT FOR MANY PLANTS AND ANIMALS AND EACH HAS ITS PLACE



Draw the plants and animals (described on Page 27) in the proper location on this water profile.

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WATER STUDY

(MIX AND MATCH)

Place the proper response in a square to the right of the proper term, as the teacher reads them.

SALMON						
DISSOLVED OXYGEN						
CRAYFISH						
SWAMP						
pH						
CADDISFLY						
BASS						
FROG						
WATERSHED						

WATER WORDS PUZZLE

DIRECTIONS

Words may go up, down, or diagonally. Circle the word when you find it.

P C M A I E V A P O R A T I O N U T W G R E T
C R A W D A D C D E O I R L M R S M A F C I Q
W A E A H B G A C N L L A X D C P E T I H K E
G Z B C O L S D W W I L N A O A J R X N T J G
L N E R I D I E Y G N E S L K O D K E N D Y R
O W H O U P Q A K E L G P R H C W E F U N C S
W I L O B H I I F R M L I B X L S R A O P O O
H A I A S T L T L W O D R U N O F F H S T N E
G E L Q U E G Z A R F K A L V U W P B U F D R
T L N T T S E J Z T C K T L G D I C I Q R E B
S I O F H T V R T G I P I R S S N V K N T N S
T M E A N H E O O V I O O U B S Z G E A D S M
R D I S E U O R U S L E N N J W I I W M H A Y
S T R E A M F L O W I F K I N C O N G N P T O
A T M O A E O O A P T O X U Q A E C R U N I M
L Y O V T R G H Q S I K N O A E N K O W I O I
A Q H L W A T E R W H E E L R R C I D L S N T
M H A O I L D E U I E F A G K A K L J S G H D
A E V A N T K M S L M T A R O G I I R H R U I
N S W R D E W G T I W E S I L A O N O N O P S
D U R A M A Y O I U A E N R N R I Y T A U C S
E O E T O M A S O M N N G S U P T S D C N A O
R I D V V I C K L S E T W A T E R S H E D E L
K M U C E H E N F L O L I E U N T P A W W S V
V P O R M C H F A E S I Q R L U E R I S A V E
A L X F E R U E I E L V A W V L A I L L T B D
J C L O N P D S P T B U L I C H C N E W E O O
B O K J T T M L G E E T N Y M P H G R U R W X
W P O R A G H O C U B I C F O O T B O X T B Y
E K E F A T M X C O L R X L Z D E Y Y V E D G
M L G A A O Y S H R E F A C A R T G A P H X E
N I L P T E S Y U T L C R A P I R C Y Z W L N
B S A L S H I O A L K A L I N E E W T V R A D
M A N M A D E W E L L C G Y T U P L E P R E W

Words you will find in this puzzle

A) Acid, Alkaline
Artesian Well

B) Bull Run

C) Clouds,
Condensation,
Crawdad,
Cubic Foot Box

D) Dissolved
Oxygen,
Dew

E) Erosion,
Evaporation

F) Fog, Frog

G) Ground Water

H) Hail

M) Man Made Well

N) Nymph

P) pH Test,
Precipitation

R) Rain, Runoff

S) Salamander,
Siphon, Sleet,
Snail, Snow,
Spring,
Streamflow

T) Transpiration

W) Water Cycle,
Watershed,
Wet,
Waterwheel,
Wind Movement

A STUDY OF SOIL

GENERAL INFORMATION

The story of soil formation begins with solid rock. Through the ages, solid rock has been broken into smaller pieces by many processes. Some of these processes include: penetration by growing roots, chemical reactions with the rock minerals, wind, moving water, glacial ice, and the freezing and thawing of water. These and other processes have formed the few inches of topsoil which support all terrestrial life on our earth.

The usually darker topsoil is built up gradually from the subsoil below it by the addition of humus from decaying plants and animals. The subsoil layer is usually lighter colored and contains less decayed plant and animal material. Because it is usually more compact, light, air, and water do not penetrate it as rapidly. Therefore, subsoils are not as favorable to the growth of plants as is the topsoil. Between the lowest subsoil and the solid rock is a layer of parent material that is mostly raw rock fragments and minerals that in the future will further break down and become soil.

As you look around your Outdoor School study area, you may find soils that have different colors, some with more sand or clay than others, some with stones on the surface, etc. These differences can be caused by a variation in the kind of rocks and plants that have formed the soils. The slope of the land, the extremes of temperature, amount of rainfall, climate, and the age, all have a part in giving each soil its individual characteristics.

When you dig below the surface of the ground in several places at Outdoor School, you may be able to see how earthworms and other small animals help to grind up materials into finer particles as they eat their way through the soil. Of course, you will want to record the animals or signs of them that you find.

WHEN YOU STUDY A SOIL SAMPLE, HERE ARE SOME OF THE CHARACTERISTICS THAT YOU SHOULD LOOK FOR:

1. Color — tells about organic matter, drainage, current animals and plant life, and fertility.
2. Texture — the feel....sandy, loamy, clayey....tells water holding capacity and how easy or difficult the land would be to work with.
3. Structure — the shape....blocky, platey, granular....tells drainage ability, aeration, and water intake.
4. Reaction pH — the pH value of a soil can affect soil fertility and can therefore affect the types of plants that will grow there. The pH of soil is determined by the use of a chemical test.

GLOSSARY OF SOIL WORDS

ACID	A pH reading less than 7.
ALKALINE	Soil that tastes sweet to plants ... measures between 7 and 14 on pH scale.
ALLUVIAL	Soils deposited on land by moving water.
BANK EROSION	Erosion is caused by streams washing away the soil from stream banks.
BEDROCK	Where present is the solid rock layer from which the parent material in a soil profile is formed.
CLAY	Soil that is smooth and sticky when wet. Composed of the smallest soil particles.
CONTOUR PLOWING	Plowing across a hill, instead of straight up and down it, to prevent erosion.
DECOMPOSE	To rot, or to decay.
DUFF	A type of organic surface horizon of forested soils, consisting of rotted peaty organic matter only slightly decomposed.
ECOLOGY	The study of how plants and animals live and work together in their surroundings.
EROSION	The wearing away of the land surface by running water, wind or other geological forces, including gravitational creep.
FERTILITY	The ability of a soil to provide the proper nutrients for the growth of plants.
GROUND COVER	Grasses, plants, shrubs or trees preventing the soil from being worn away by wind or water.
GULLY EROSION	Washes away the soil by water running downhill and making deep, wide ditches.
HORTICULTURE	The science and practice of growing fruits, flowers and vegetables.
HUMUS	Well decomposed plant and animal material in soil.
INORGANIC	Anything that has never been living.
LICHEN	A pioneer plant that helps break down rock by secreting an acid from its roots.
LOAM	A soil rich in humus and containing clay, silt, and fine sand.
ORGANIC	Anything that is living, or has been living.

PARENT MATERIAL	When present, is located beneath the subsoil and is made up of partly decomposed rocks or sand that help to form subsoil.
pH	A test that shows whether a soil is acid (sour) neutral or alkaline (sweet).
RESIDUAL	Soil developed in place by the decay of underlying parent material.
RILL EROSION	Washes away the soil by water running downhill and making many little streams.
SAND	Soil that feels gritty, and does not hold together.
SHEET EROSION	Washes away the layers of soil.
SILT	Smooth soil, with a slippery, silky texture.
SOIL	A natural body on the surface of the earth, in which plants grow, composed of organic and mineral materials.
SOIL PROFILE	A side view of the layers of soil.
SPLASH EROSION	Is caused by raindrops hitting bare soil.
STRIP CROPPING	Planting rows of different crops to hold the soil together against erosion.
STRUCTURE	Refers to the slope of the soil, whether it is blocky, platey, granular etc. Structure tells the drainage, permeability, aeration, and water intake capabilities of the soil.
SUBSOIL	The soil layer directly beneath the topsoil. It provides moisture and some minerals and support to large plants.
TERRACING	The construction of broad steps across the face of a slope to prevent erosion by allowing water to be absorbed into the soil or by allowing it to run slowly on the contour to an outlet at a nonerosive speed.
TEXTURE	The size of individual soil particles.
TOPSOIL	A general term applied to the surface portion of a soil.
WEATHERING	The breaking down of rocks and minerals.

WORD FIND

A B G H U M U S P A L L U V I A L D
C W E F G H I J K E R O S I O N I L
R E S I D U A L T E R R A C I N G G
O A P D I T E X T U R E C P Q R R G
K T R N S T R I P C R O P P I N G G
C H E A T U V W X O Y Z R A B C R R
O E S S O I L P R O F I L E D L S O
R R E E F B G G U L L Y H I I J T U
D I R T K A A M E L N O P O Q A R N
E N V R R N N T U S S U S S O L U D
B G A W I K X Y I Z O P H O A K C C
L C T C D U A L E T O P E F I A T O
O H I J K T T E E M N M M P L L U V
A R O S D T U E V W X Y D O X I R E
M B N I C J H S A L P S D U C N E R
E F C O N S E R V A T I O N F E H H
P A R E N T M A T E R I A L G F D D

You will find many of your soil vocabulary words in the word find above. Words are forwards, backwards, and diagonal. There are 28 possible words. Draw a line through the letters. Remember words are forward, backwards, and diagonal.

GOOD LUCK!!!

ALLUVIAL
ACID
ALKALINE
BANK
CONSERVATION
DECOMPOSE
DIRT
DUFF
EROSION
GROUND COVER
GULLY
HUMUS
LOAM
ORGANIC
PARENT MATERIAL
pH
PRESERVATION
RESIDUAL
SHEET
SILT
SOIL
SOIL PROFILE
SPLASH
STRIP CROPPING
STRUCTURE
TERRACING
TEXTURE
WEATHERING

UNSCRAMBLE THESE SOIL VOCABULARY WORDS

1. DNAS _____
2. HEETS REONSIO _____
3. GREHNITAEW _____
4. LSIBUOS _____
5. LYULG _____
6. PIRTS PROPGINC _____
7. NOSEOIR _____
8. FUDF _____
9. SEEPOMEDC _____
10. ALLINKEA _____
11. VESTRANNOICO _____
12. OILS _____
13. RAESTM NABK _____
14. MUSHU _____
15. RTIEFEL _____
16. LUIALAVL _____
17. ESRIUDLA OILS _____
18. CAINGOR _____
19. ACYL _____
20. OORUNCT GIWNOPL _____
21. RACERGINT _____
22. LOSI LIFEROP _____
23. PHASSL OINORES _____
24. LIST _____
25. GANNCIIOR _____
26. LIRL _____
27. DACI _____
28. LIPSOOT _____
29. TENARP LATERIAM _____
30. CODKREB _____
31. NUDORG EVROC _____
32. ICULTROHEURT _____
33. ERUTCURTS _____
34. TREUEXT _____

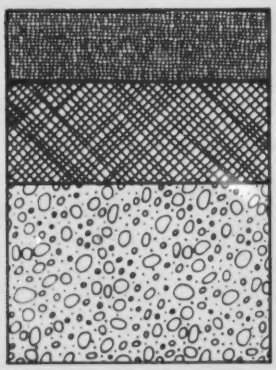
THE SOIL PROFILE

When you study soil at Outdoor School you will have a chance to investigate a soil profile. A soil profile is a side view or cross section of the soil area being studied. By studying the soil profile we can tell how the soil was formed and how well it is drained. Also, we can learn about the soil's fertility and stability. All of these factors must be known if the soil is to be used properly.

No two soil profiles are exactly alike. Many factors contribute to the number of levels or horizons in an individual soil profile. Two broad divisions of soil are: alluvial (water borne soil), and residual (soil formed in place). Man can also have an effect on the soil profile particularly in a farm field. Cultivation eliminates the natural organic cover on the soil, therefore duff is not found on cultivated fields.

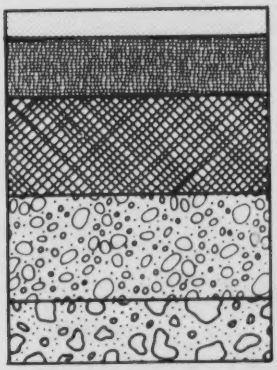
Look at the two sample soil profiles on this page. Notice the difference in the number and type of layers (or soil horizons). Discuss these differences with your teacher. When you feel that you understand them, complete the soil profile problems C and D. Be careful to notice the type or origin of the soil and what is growing on the soil before you begin labeling the different horizons.

Cultivated Farm Field
Alluvial Soil



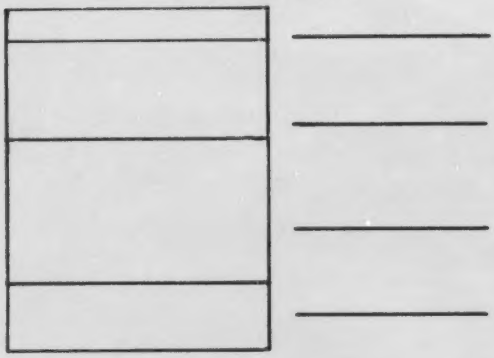
A

Undisturbed Forest
Residual Soil



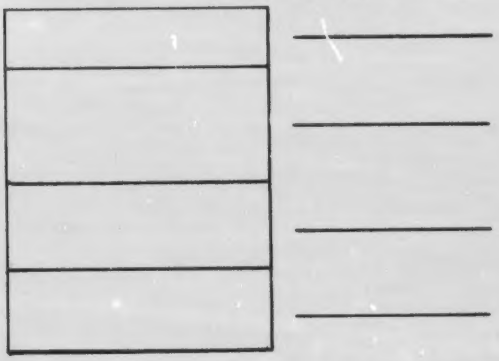
B

Undisturbed Forest
Alluvial Soil



C

Cultivated Farm Field
Residual Soil



D

Use the same colors or code that you used in A and B in completing C and D profiles.

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FARM FUN

OR

(HOW TO PLANT THE RIGHT CROP IN THE RIGHT pH AND RAISE A GOOD CROP)

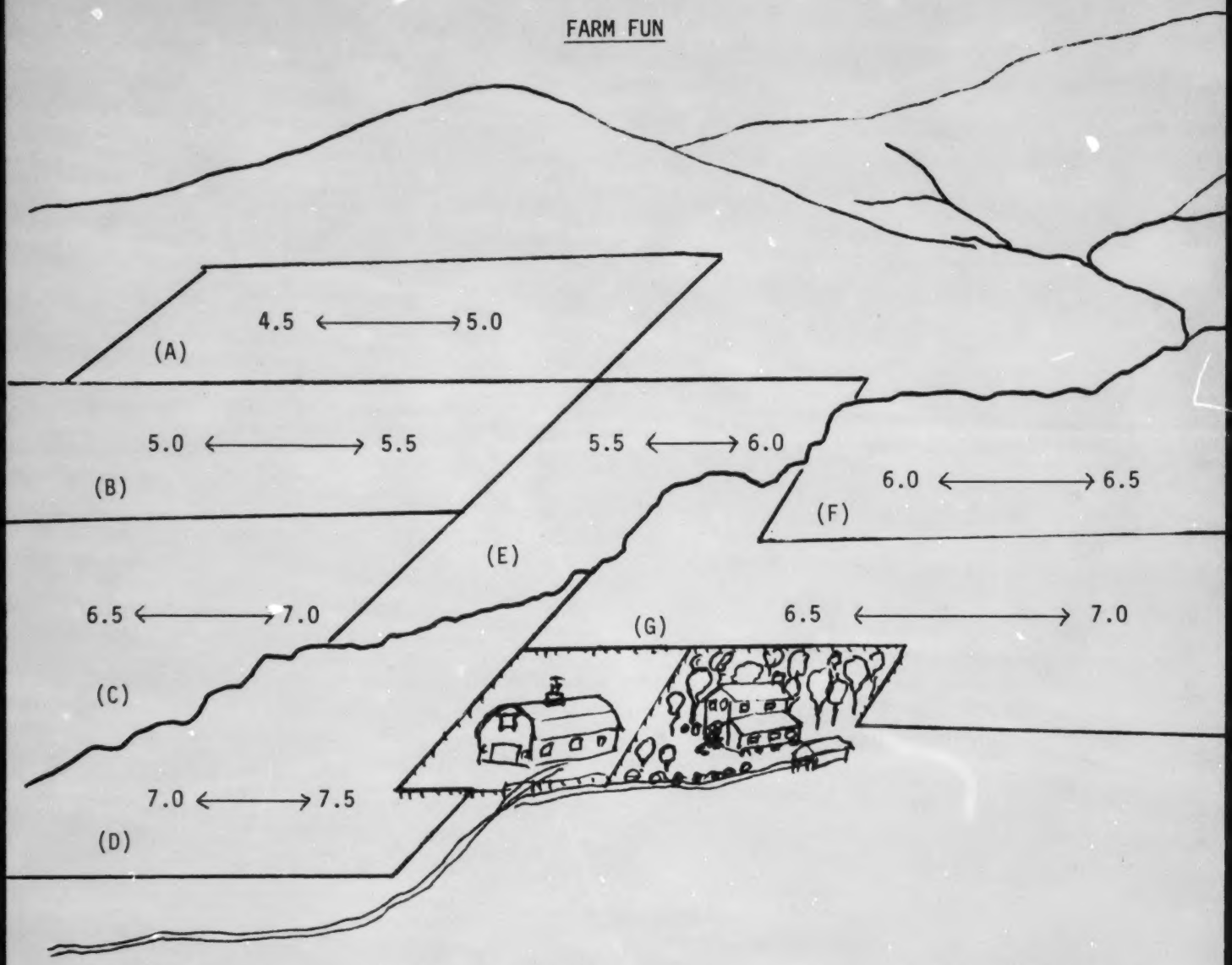
Each plant prefers a different soil pH. Just as you might like sweet-tasting foods (like ice cream) better than sour-tasting food (like lemons), plants prefer different kinds of soil. Some plants might grow best in sour soil (which is acid on the pH scale), and others might grow best in sweet soil (which is alkaline on the pH scale). But, most plants grow best in soil that is close to neutral or 7 on the pH scale. Extreme readings (refer to "Description of pH" in water section) in either an acid or alkaline direction, prevent a plant from taking in many nutrients.

On the next page there is a picture of a farm. Since this is your workbook, this must be your farm. It's a nice farm, with good land, and you want to plant the best crops so that you can make a living from your farm. Well, so far, you have been very smart....you have tested the pH of your soil and found that there were five pH ranges on your farm. Now, you have one rather large problem....you know what you want to plant, but you must plant the crop in the soil with the right pH or that crop won't grow satisfactorily. If the crop doesn't grow, you will lose money. If the crop does grow well, you will have a crop to sell!

Following is a list of crops you may want to plant. The list also contains a soil pH value that this crop requires. Look at the soil map of your farm and plant your crops in the fields having pH values that agree with the crops you have chosen. Write the name of the crop in the space provided at the bottom of the page next to the letters which identify the fields. Please plant a crop in every field.

There are many other factors that are also important and must be considered when choosing a crop. Climate and growing season (the number of frost-free days), rainfall, or the availability of irrigation, fertility, depth of soil, slope, exposure, market factors, and many more. Everyone should know that the pH exercise is only one factor of many that farmers must consider when choosing a crop. Many crops, particularly orchards and berries, are long-lived and are not planted every year.

FARM FUN



Find crops on the following page that could grow well in each field. Write one crop by each letter below that could best grow in that field. Try to grow a variety of crops.

ANSWERS

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

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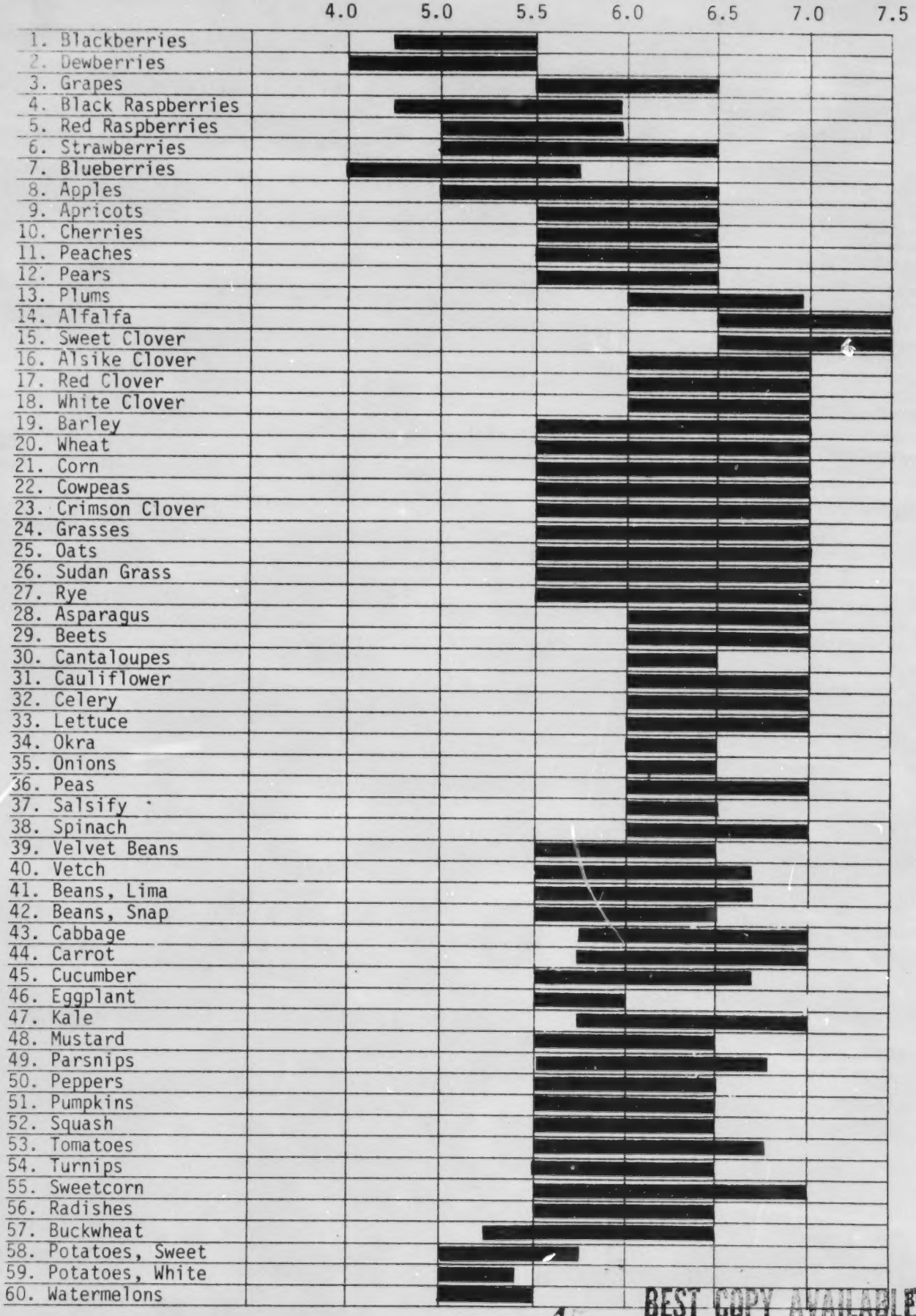
BEST SOIL pH RANGE FOR VARIOUS CROPS



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SOIL CROSSWORD PUZZLE #1

PLEASE USE YOUR SOIL VOCABULARY

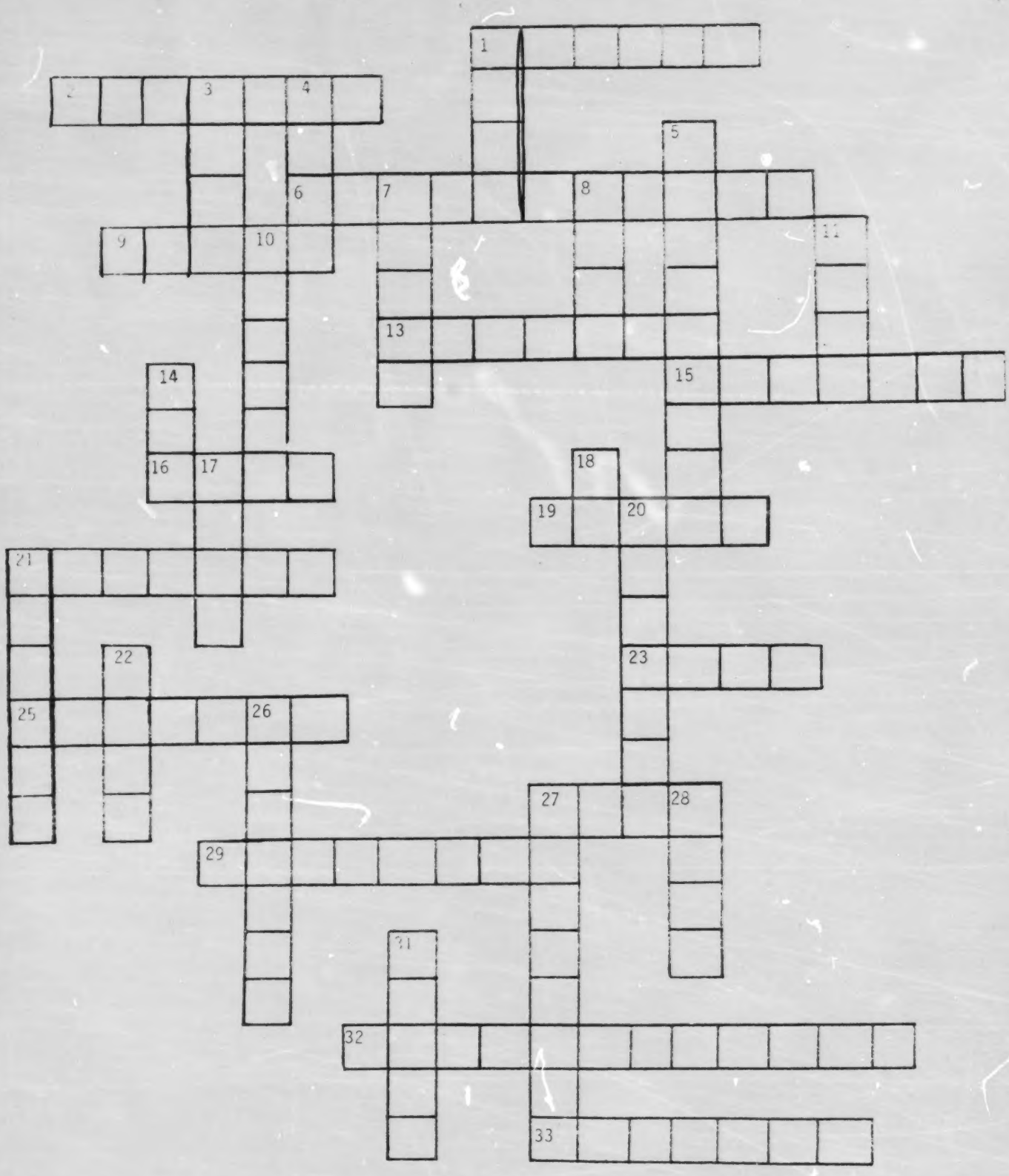
ACROSS

1. Type of erosion caused by raindrops hitting bare soil.
2. The solid rock underlying the soil layers.
6. Type of erosion speeded up by man's misuse of land.
9. Type of erosion which leaves ditches that may be too deep and wide for farm machinery to cross.
13. Matter which is living or has been living, and is subject to decay or bacteria.
15. The feel of soil.
16. Type of erosion caused by streams washing soil from stream banks.
19. Type of erosion in which water removes the top layer of soil without easy to see channels.
21. A cross section view of the soil layers.
23. A smooth soil with a silky, slippery texture.
25. The study of the inter-relationship of plants and animals, and their environment.
27. Small rock or mineral fragments having a size larger than silt or clay.
29. When a substance has a pH greater than 7.0, it is _____.
32. Wise use of our natural resources.
33. The layer of soil which contains nutrients that support plant growth.

DOWN

1. A mixture of decayed organic and inorganic matter which usually supports plant growth.
3. Type of erosion which leaves many small, easy-to-see channels.
4. Soil that is smooth and sticky when wet, composed of the smallest soil particles.
5. The shape of soil particles.
7. Topsoil is usually a darker _____ than subsoil.
8. Liquid precipitation which can cause erosion.
10. A plant which grows on rock and helps turn rock into soil by secreting an acid from its roots.
11. The part of a plant which is in the soil.
14. Under the topsoil is _____ soil.
17. When a substance has a pH of less than 7.0, it is _____.
18. The measure of acid or alkaline in a substance.
20. The act of wearing away soil by wind or water.
21. The layer of soil consisting of broken up rock and sand which is under the subsoil is called _____ material.
22. Soil composed of an ideal mixture of sand, silt, and clay.
26. The study of the earth's crust.
27. Particles deposited after suspension in water, as when flowing water slows down.
28. A type of organic surface horizon of forested soils, consisting of rotted, peaty organic matter only slightly decomposed.
31. A slanting or tilted land surface.

SOIL CROSSWORD PUZZLE #1



SOIL CROSSWORD PUZZLE #2

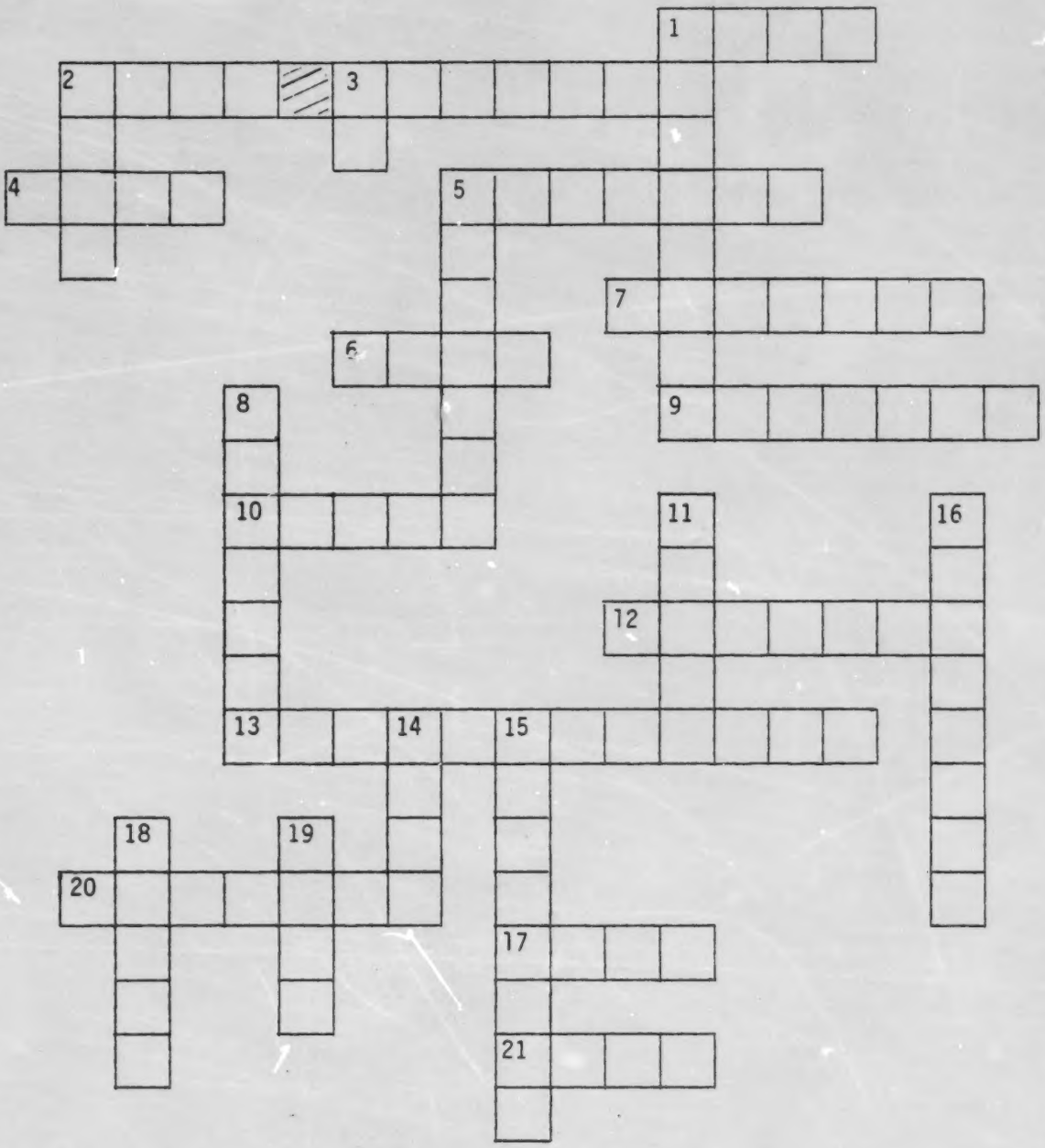
ACROSS

1. Small rock or mineral fragments larger than silt and clay.
2. Shows layers of soil (two words).
4. Composed of the smallest soil particles.
5. Major soil problem.
6. Smallest erosion channels.
7. Soil which can supply needed nutrients for plant growth.
9. Generally fertile top layer of soil.
10. Deep erosion that generally cannot be erased by a plow.
12. Contributes to the development of residual soils.
13. Wise use of our natural resources.
17. Undecomposed organic layer.
20. Mineral bearing soil layer underneath topsoil.
21. Generally the pH of soils in high rainfall areas.

DOWN

1. Particles that settle in water or are deposited by a stream.
2. Soil particles larger than clay and smaller than sand.
3. Measure of acidity or alkalinity.
5. Study including soil, plants, water, and animals and their effects on each other.
8. Is or was living.
11. Washes away layers of soil.
14. Decomposed animal, plant, and rock that can support plants.
15. Soil formed in one place.
16. Generally the pH of (arid) eastern Oregon soils.
18. Decomposed plant and animal matter.
19. Mixture of sand, silt, and clay.

SOIL CROSSWORD PUZZLE #2



WORD GAMES

(Or....a fun and painless way to learn your vocabulary words.)

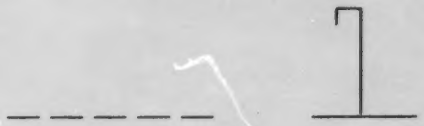
I. SOIL SECRETS

1. Choose one of your soil vocabulary words.
2. Stand in front of the class.
3. One person at a time will ask you a question about your secret word. Answer the question "yes" or "no".
4. If the answer is "yes", the same person asks another question. If the answer is "no", a different person asks a question.
5. The class has twenty questions to guess your secret soil word.
6. Whoever guesses your secret word, is the next person to have a turn.

II. SOIL HANGMAN

1. Draw a picture of a hangman's platform. Draw lines that show the number of letters in the soil word you have chosen.

   Example: Gully

2. The class will guess if a certain letter is in the word.
3. If they are right, you write the letter in the space. If they are wrong, you draw the first part of the body, and write the letter on another list.

   Example: The guess was "A". Wrong: So draw a head.

4. For each wrong guess, you draw a part of the body.
5. If you finish drawing the body before the class guesses all the letters in the word.....you win!!

DIRECTIONS: To play SOIL BINGO, choose just one of the four cards. As your teacher reads a question see if you have the answer to that question on your card. If you do, put a marker in that space. When you have five markers in a line, you have BINGO!

After you have been to Outdoor School, you will know many more words than are on these cards. You might want to make more BINGO cards, using all the new words you learned at Outdoor School.

B	I	N	G	O
WEATHERING	BEDROCK	ACID	PARENT MATERIAL	ALLUVIAL
ALKALINE	HORTI-CULTURE	RAINFALL	SAND	GROUND COVER
EROSION	SHEET EROSION	FREE / FREE	TOPSOIL	pH
SUBSOIL	DECOMPOSE	ORGANIC	PLANTS	DUFF
BANK EROSION	CLAY	RILL EROSION	LOAM	TERRACING

A

B	I	N	G	O
PRESERVA-TION	PARENT MATERIAL	GROUND COVER	AIR	EROSION
CONTOUR PLOWING	WEATHERING	SLOPE	BEDROCK	SUBSOIL
RILL EROSION	CONSER-VATION	FREE / FREE	DUFF	LOAM
pH	TERRACING	TOPSOIL	SOIL CONSER-VATION	CLAY
SEDIMENT	ORGANIC	ALKALINE	ACID	WATER

B

B	I	N	G	O
SOIL	ORGANIC	TOPSOIL	GROUND COVER	CLAY
DUFF	CONTOUR PLOWING	pH	HUMUS	ALKALINE
TERRACING	FERTILIZER	FREE / FREE	EROSION	BEDROCK
LOAM	ACID	INORGANIC	HORTI-CULTURE	RILL EROSION
SUBSOIL	PARENT MATERIAL	WEATHERING	SAND	SOIL PROFILE

C

B	I	N	G	O
TEXTURE	SAND	INORGANIC	ALKALINE	PARENT MATERIAL
ACID	GULLY EROSION	TOPSOIL	STRUCTURE	ORGANIC
RILL EROSION	GROUND COVER	FREE / FREE	LOAM	FERTILE
EROSION	WEATHERING	SPLASH EROSION	SUBSOIL	HORTI-CULTURE
pH	BEDROCK	TERRACING	CLAY	STRIP CROPPING

D

STUDY OF PLANTS

At Outdoor School one day will be spent studying the plants growing there. You will soon discover that certain plants are usually found associating together, just as you tend to be with your friends and family in a community. Plant communities exist because they share certain physical conditions in their surroundings that agree with that group of plants, and do not agree with others. In another area with another set of conditions, another grouping of plants will grow together in a community. These growth conditions may include the types of soil present, the drainage conditions, moisture conditions during the growing season, the temperature, the elevation, climate, and whether the slope of the land is toward the north or south (exposure to the sun).

You will also notice that plants differ from one another and can be separated or "classified" by means of these differences. The main groups are flowering plants, ferns, mosses, lichens, fungi and algae. Plants grow generally in three levels: (1) upper level - 30 feet and above, (2) middle level - from 3 to 30 feet, (3) lower level - below 3 feet. When we are able to classify plants we can then determine which ones grow together in a community, and whether there are plants from other communities that have similar characteristics and are part of the same "family".

Of course, not all plants grow in forests. In Oregon we also have natural prairies, meadows and a great deal of arid country east of the Cascade Mountains. Much of Oregon contains only lower level plants, but plants grow almost everywhere in our state and in the world. Can you name some areas in the world where plants do not grow? (Possible: the top of Mt. Everest, the middle of the Sahara Desert, on the Polar Ice Cap.) Why do you think they won't grow in these areas, at least in abundance?

As you prepare to study plants at Outdoor School start thinking about how important plants are to your life. Can you think of a food which doesn't come from plants? (Yes, but what does the cow eat?) How much paper do you use in a day? What are most things packaged in? How many things around your home or in the classroom are made from plants? What are you wearing? (Yes, but what does the sheep eat?)

In our state of Oregon, forest products are the major source of income for our people, more than in any other state in the union. Trees are a renewable resource as long as we take care of the land and try to understand that trees are only a part of the plant community and that forests give us much more than trees. Can you name some of the many things we get from a forest that are not made of wood? Why do we like to walk in the forest? Where does wildlife live? Where does nature store water for a year-round supply?

GLOSSARY OF PLANT WORDS

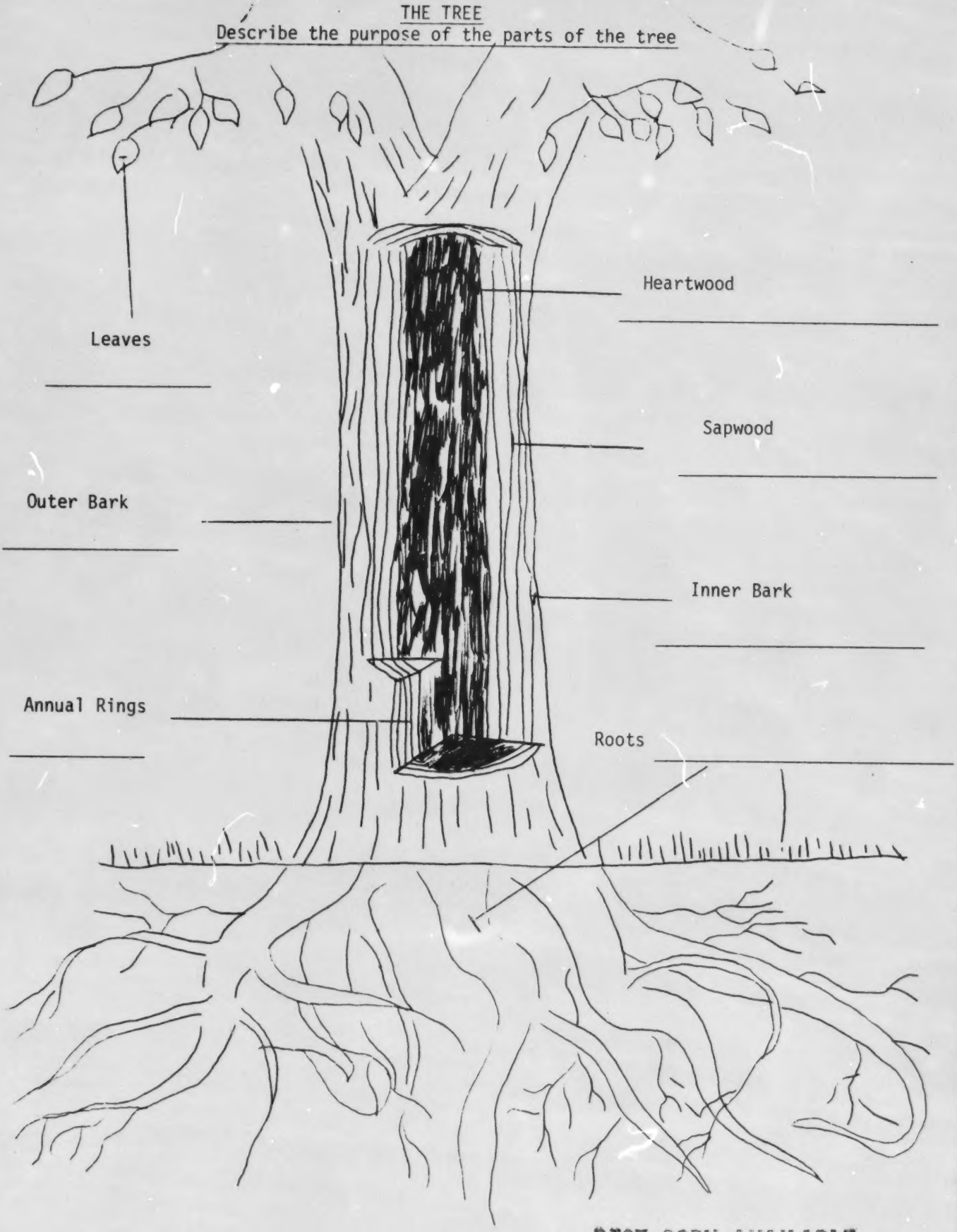
ALGAE	Most primitive form of plant from which all other groups of plants have probably been derived. They vary in size from very small land forms to giant seaweed as long as 150 feet. This is the green material on the side of a fish bowl.
ALTERNATE	Leaf pattern...leaves growing first on one side of the stem and then on the other, but not across from one another.
BARK	Protective covering on the outside of a tree or shrub.
BERRY	Any small juicy and stoneless fruit.
BOARD FOOT	Unit of measuring lumber (12" x 12" x 1").
BROAD LEAF	A plant having flat, broad leaves, instead of needles like on pines, firs, etc.
BUSH	Any low shrub with many branches.
CAMBIUM LAYER	Layer of growing tissue between the bark and the sapwood.
CARBON DIOXIDE	Gas which we breathe out and the plant takes in during photosynthesis (daytime).
CHLOROPHYLL	The green coloring matter of plants necessary for the plant to make its own food (photosynthesis).
CIRCUMFERENCE	Measurement around a circle.
COMMUNITY	A group of plants growing in the same area and in the same conditions.
COMPOUND LEAF	Leaf consisting of several leaflets attached to a single leaf stem.
CONE	The seed-bearing body of such trees as Douglas fir, hemlock, pines, etc.
CONIFER	A tree which is usually evergreen and has needle-shaped leaves. It is a cone bearing tree.
CORD	A measure of wood 8 feet by 4 feet by 4 feet.
D.B.H.	Diameter of tree at breast height (4½ feet).
DECIDUOUS	A plant whose leaves drop off in the fall of the year.
DIAMETER	Length of a line from one side of a circle to the other through the center.
DUFF	Partially decayed organic matter on top of the soil.

EVERGREEN	A plant which stays green all year.
FERN	A plant with feather-like leaves which reproduces by spores.
FLOWER	The part of a plant which contains the organs of reproduction from which seeds develop.
FUNGUS	Form of plant life which has no chlorophyll so must obtain its food from other living things.
GROWTH RINGS	The amount of wood a tree adds in one season of growth.
HEARTWOOD	The inner core of a tree trunk made of non-living cells which is usually darker than sapwood. Gives the tree strength.
HORTICULTURE	The science and practice of growing fruits, vegetables and flowers.
INTOLERANCE	Plants that cannot withstand adverse environmental conditions.
LEAF	A green, usually flat part of a plant that grows from the stem or roots and is the place where most photosynthesis takes place.
LICHEN	A plant which consists of two separate plants....an algae and a fungus.
LOBED	Leaf having deep indentations between the major veins.
MOSS	A primitive plant form that reproduces by spores instead of seeds.
NEEDLE	A thin, pointed leaf; like that of the Douglas fir.
NURSE LOG	Decaying log which provides a seed bed for other plants.
OPPOSITE	Leaf pattern...leaves growing across from one another on a stem.
OXYGEN	Colorless gas that is given off by plants during photosynthesis.
PALMATE	A leaf arrangement in which several leaflets start from a single point and form a shape like a hand with fingers.
PETAL	One of the divisions of a flower which is usually brightly colored.
PHOTOSYNTHESIS	The process by which plants use water, CO_2 and sunlight to make food.
PINNATE	A simple leaf having a large middle vein and smaller vein arranged like a feather.
PLANT SUCCESSION	A process in which plant communities are replaced by other communities over time.
ROOTS	Part of a plant which usually grows in the ground. It anchors the plant and feeds the plant.

SAP	The liquid inside the trunk of a tree that carries nutrients to plant cells.
SAPWOOD	Soft living part of trunk which contains tubes which carry water and minerals from roots to leaves.
SEED	The reproductive part of a flowering plant which contains the egg cell.
SIMPLE LEAF	A leaf which isn't divided.
SPORES	One-celled seeds found in plants; like ferns.
STEM	The portion of a plant that supports leaves, buds, flowers and fruits.
TEETH	Projections on the edges of leaves which look like teeth.
TOLERANCE	The ability of a plant to withstand adverse environmental conditions.
TREE	A plant that usually grows tall and which has a trunk and branches.
TRUNK	The main stem of a tree.
WHORLS	A circular arrangement of leaves or branches on a stem at one point.

THE TREE

Describe the purpose of the parts of the tree



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MIX AND MATCH

PLANT CHARACTERISTICS

Label each of the items below using the following terms:

1. Palmately Compound Leaf
2. Whorl Branched
3. Alternately Branched
4. Pinnately Lobed Leaf
5. Simple Leaf
6. Opposite Branched
7. Palmately Lobed Leaf
8. Needle Leafed
9. Compound Leaf

_____

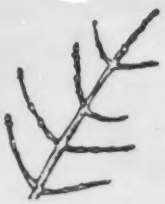
_____

_____

_____

_____

_____



_____

_____

_____

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UNSCRAMBLE THESE PLANT WORDS

1. TONSSIHPOYHEST _____
2. GUSNUF _____
3. LOPHOCYLRHL _____
4. FUDF _____
5. GEERVERNE _____
6. NATATELER _____
7. TOPSOPIE _____
8. PUDMONOC _____
9. KONC _____
10. TOADBOROF _____
11. CUDSIUDEO _____
12. RONICESUOF _____
13. MAREDIET _____
14. NECO _____
15. KABR _____
16. SROTO _____

UNSCRAMBLE THE NAMES OF THESE OUTDOOR SCHOOL PLANTS

1. SADUOLG RFI _____
2. NERTEWS DER REDAC _____
3. NERTESW KEMHCOL _____
4. FCICAPI WYE _____
5. DER LERAD _____
6. GAEFIBL EPLMA _____
7. NERTWSE OOODWG _____
8. ABLCK NOOTCDOOWT _____
9. NIEV PMAEL _____

MIX AND MATCH

Find the definition on the right which matches the word on the left and write the letter in the space provided.

1.	Photosynthesis _____	A.	Trees and shrubs that loose their leaves yearly
2.	Chlorophyll _____	B.	Cone bearing trees
3.	Douglas fir _____	C.	Measurement through a circle
4.	Whorl _____	D.	Anchors the tree
5.	Opposite _____	E.	Official Oregon State flower
6.	Conk _____	F.	Trees which stay green all year
7.	Deciduous _____	G.	Dead plant material on the forest floor
8.	Coniferous _____	H.	Official Oregon State tree
9.	Cone _____	I.	A circular arrangement of leaves or branches on a stem at one point.
10.	Roots _____	J.	A board measuring 12 x 12 x 1 inches
11.	Bark _____	K.	Protects a tree
12.	Oregon Grape _____	L.	Green material in plant cells
13.	Diameter _____	M.	A plant which is unable to make its own food
14.	Maple _____	N.	Holds seed
15.	Board Foot _____	O.	Seeds are like helicopters
16.	Compound _____	P.	Evergreen with droopy top and small cones
17.	Hemlock _____	Q.	A leaf composed of many leaflets
18.	Evergreen _____	R.	Leaves growing across from each other
19.	Duff _____	S.	Plants able to make their own food
20.	Fungus _____	T.	Hard woody fungus commonly found on the side of trees

PLANT WORD FIND

Find these 45 missing words that are written vertical, horizonal, or diagonal, but always forward!

CHLOROPHYLL
PHOTOSYNTHESIS
LEAF
TRUNK
ROOTS
BARK
PETAL
STEM
TEETH
COMMUNITY
PLANT SUCCESSION
BERRY
LEVEL
ALTERNATE
OPPOSITE
WHORLS
SIMPLE
COMPOUND
PINNATELY
PALMATELY
CARBON DIOXIDE
OXYGEN
NEEDLE
CONE
SEED
SAP
NURSE LOG
BOARD FOOT
CIRCUMFERENCE
DIAMETER
GROWTH RINGS
SPORES
WATER
BROAD LEAF
ALGAE
TREE
CONIFER
EVERGREEN
DECIDUOUS
D.B.H.
HEARTWOOD
SAPWOOD
INTOLERANCE
OREGON GRAPE
FLOWER

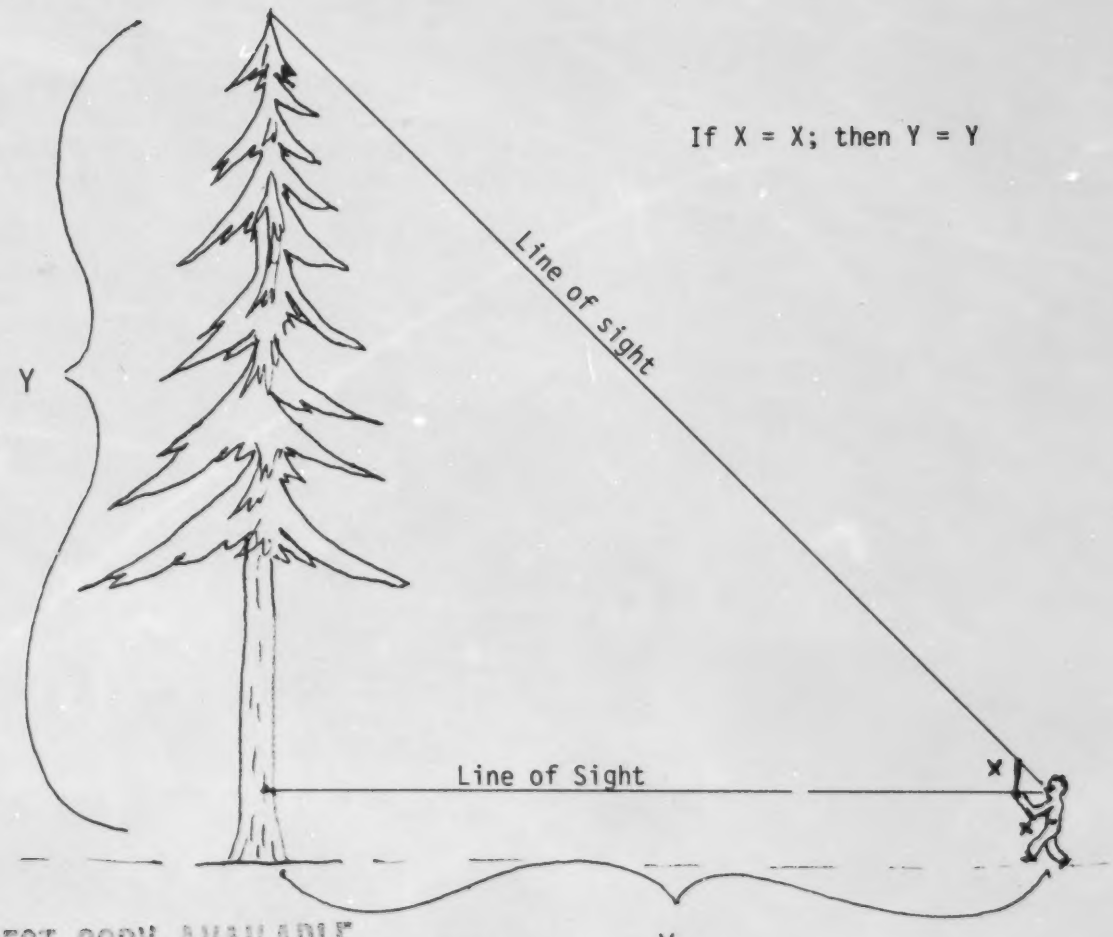
F C A A U S H S P O R E S B X C A
L I H E A R T W O O D A S Q S O C
O R S T O P S E W H O R L S A N D
W C A B R M C O M P O U N D P I H
E U N D E C I D U O U S L X G F J
R M P B G E V E R G R E E N O E O
A F G H O A L G A E B C A R P R X
P E S T N O P K L R A B F O P S Y
A R I J G H H I T T R S T O O P G
L E M A R S O P R S K T U T S C E
M N P L A N T S U C C E S S I O N
A C L T P R O A N V H E T B T M G
T E E E E F S P K L L T R O E M R
E B P R N L Y W L M O H E A D U O
L R I N O E N A S T R N E R I N W
Y C N A S V T T A B O N O D A I T
X A N T S E H E P C P U V F M T H
Y D A E P L E R W X H R S O E Y R
Z L T S Q M S D O P Y S T O T S I
N E E D L E I J O P L E F T E F N
M A L M N O S T D E L L M N R S G
P F Y C A R B O N D I O X I D E S
I N T O L E R A N C E G B E R R Y

THE TREE

HOW TO MEASURE THE HEIGHT

1. Choose a stick the same length as your arm held out in front of you.
2. Now hold stick upright to form a right angle.
3. Walk backward away from the tree on level ground, sighting across the upper end of the stick you are holding upright and the bottom of the stick above your fist.
4. Continue to walk backward until you can see the top of the tree at the top of the stick and the bottom of the tree at the top of your fist.
5. You are now the same distance from the tree as the height of the tree. Measure the distance from you to the tree and you will have the height.

Number of steps _____ x length of step _____ = height of tree



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ANIMALS

All animals have the same priorities:

A. To stay alive:

   a. To obtain food, water, and shelter.
   b. To avoid being killed or eaten.

B. To reproduce:

   a. To find a mate.
   b. To provide food, water, and shelter for the young.
   c. To protect the young from predators.

In some species, such as most reptiles and amphibians and many of the insects, the care and protection of the young is neglected, but is replaced by having an over-production of young, allowing many of them to die from neglect or being eaten, and still having enough survivors to carry on the species.

The birth rate and the death rate in any species must be equal if the species is to maintain its status. Any kind of animal with a high death rate must have many young, or become extinct. Species which carefully raise their young to maturity must have few offspring or their numbers will increase until they have exhausted their food supply or shelter. This is called over-population.

In nature, over-population does not often occur, because when a food-species exists, predators will move in to harvest the excess. Each animal is a source of food to some other animal. When mice are abundant, the hawks, foxes, weasels, and other animals that eat mice will increase rapidly. They will have plenty of food for their young, and so can have more offspring. As these young are better fed, more of them will grow to maturity. As the mouse population drops from being over-harvested, these predators which eat mice become less inclined to breed. Of those which do breed, fewer of their young will grow to maturity because of starvation, or disease brought about by malnutrition. Also, when there are fewer mice, the hungry predators will turn to other food, including the young of other predators, and thus decrease their population. Many of them will then travel to other places where there is more food, and so help in controlling over-population there.

TERMS USED IN ANIMAL STUDY

This list is not intended to be used as a dictionary, but rather as an aid to improving your vocabulary before attending Outdoor School. The terms are not in alphabetical order, but are in related groups; each group small enough to be easily learned. In the definitions, the words in CAPITAL LETTERS are important things to remember.

VERTEBRATE	An animal with a BACKBONE.
INVERTEBRATES	Animals WITHOUT BACKBONES. Some have exoskeletons.
EXOSKELETON	The OUTSIDE SKELETON of animals such as insects and crayfish.

VERTEBRATES

MAMMAL	Warm-blooded vertebrate, HAIR, FEEDS YOUNG ON MILK.
BIRD	Warm-blooded vertebrate, FEATHERS, eggs with limey shells.
REPTILE	Cold-blooded vertebrate, DRY, SCALY SKIN (snake, lizard, turtle).
AMPHIBIAN	Cold-blooded vertebrate, SKIN SMOOTH AND SLIPPERY (frog, salamander).

INVERTEBRATES WITH EXOSKELETONS

INSECT	THREE-PART BODY, SIX LEGS; adults usually have wings.
SPIDER	TWO-PART BODY, EIGHT LEGS, no wings.
CENTIPEDE	Exoskeleton in many sections, each section having 2 legs (1 pair).
MILLEPEDE	Exoskeleton in many sections, each section having 4 legs (2 pairs).

INVERTEBRATES WITHOUT EXOSKELETONS

SNAIL AND SLUG	NO SKELETON, SLIMY, ONE LONG, FLAT FOOT, with or without shell.
EARTHWORM	NO SKELETON, SLIMY, long segmented body, no legs.
CARNIVORES	Animals that eat meat.
HERBIVORES	Animals that eat plants.
OMNIVORES	Animals that eat both meat and plants.
PREDATORS	Animals that kill other animals for food.
SCAVENGERS	Animals that eat dead and decaying animal and plant life.
PARASITES	Animals or plants that obtain food from living organisms.
DIURNAL	Most active during daylight hours.
NOCTURNAL	Most active at night.
HIBERNATE	To spend the winter in a deep sleep usually because of cold.
ESTIVATE	To spend the summer in a deep sleep usually because of drought.
AQUATIC	Living or growing in water. Applied to either plants or animals.
TERRESTRIAL	Living or growing on land; either plants or animals.
NATIVE	An animal or plant naturally found in this area.
EXOTIC	An animal or plant NOT NATIVE to this area (imported).
ENVIRONMENT	All those factors which make up the surroundings of any living thing.
HABITAT	The environment in which an animal can exist, providing all of the things that the animal must have; WATER, FOOD, AND SHELTER.
CARRYING CAPACITY	The maximum population that a given environment can support indefinitely.
LIMITING FACTOR	Whichever of the three essentials, WATER, FOOD, OR SHELTER is used up first, thus limiting the carrying capacity.

THE INSECT

The place that the insect occupies in the world of living things is important because most all plants and animals are affected in some way by their presence. Two-thirds or more of all kinds of animals on this earth are insects. They are individually outnumbered only by microscopic forms of life. Over 900,000 different species of insects have been identified and experts believe this may be only 10% of the insects yet to be discovered.

Insects play a very important role in our lives because some are pests and others are beneficial. While the common fruitfly can destroy thousands of dollars worth of cherries in Oregon each year, we would not have any cherries, or apples, or grapes, or clover without the bees and similar insects.

All insects have six legs and only six. The body of an insect is divided into three regions, the head, thorax, and abdomen. The three pairs of legs are found on the thorax and an insect may or may not have wings. The insect is protected and held together by a suit of armor called the exoskeleton. It has no inside skeleton like a human. The insect breathes, not through his mouth or nose like a mammal, but through holes in his body wall.

In 1951 crop losses due to insects were estimated at $10,200,000,000 for the United States alone where over $400,000,000 is spent each year to keep insects under control.

Why is there such a problem with the "little" insect? It is mainly because of the insect's unbelievable potential to multiply. A good example is the common cabbage aphid found in almost any garden. A single female aphid averages 45 offspring per generation and there are usually 12 generations a year. Starting with a single female and assuming all the offspring of each generation survive and each offspring produce 45 more aphids, in one year (12 generations), 822,250 tons of aphids would be produced. Fortunately all aphid offspring don't survive and those that do, are kept in check by man.

KREEPY KRITTERS

Insects, spiders, centipedes, etc. (as well as clams, crabs, etc.) have what is known as an exoskeleton (Greek: exo, without or outwards; skeletos, hard), a hard outer sheath that serves as a skeleton, gives shape and rigidity to the body, acts as armor to prevent injury from without, and prevents loss of water by evaporation. There is a limit to the size that an animal having an exoskeleton can be, as this type of muscle attachment will not work on a very large muscle. Not being surrounded by living tissue the skeleton cannot grow, therefore, the animal can grow only a very little within its shell. It is then necessary to shed its covering and to replace it with a larger one. This process, repeated many times in the growth of the animal, is called molting. Early in the molting process, the animal becomes immobilized while his old coat loosens. It then splits down the back and he crawls out of it, but he is very soft and unable to travel far until his new shell hardens. At this time he is extremely vulnerable.

Most kreepy kritters give no care whatever to their young, depending entirely on over-production to perpetuate the species. Some females lay more than a million eggs in their lifetime. Such over-production is balanced in nature by birds, reptiles, fish, amphibians, and mammals as well as by other kreepy kritters who depend on bugs for food. Some birds eat hundreds of insects in a single day. Anything that destroys these insect eaters will allow bugs to multiply at an almost unbelievable rate. The increase is compounded by several thousand with each generation and some insects have another generation every few days. Some species that care for their young and therefore have a relatively high survival rate prevent over-population by having one queen who lays all of the eggs for the colony. All other females are sterile, and few males are produced.

CENTIPEDES (Latin: centum = hundred; pedis = foot) flattened, segmented animals with one pair of legs on each of from 14 to 180 segments; the front pair usually modified into poisoned claws with which to inject venom into their prey. Can be painful, but rarely fatal to humans.

MILLIPEDES (Latin: mille = thousand; pedis = foot) are slow moving with rounded bodies and numerous segments, each with two pairs of legs. Short antennae. Usually found on decaying vegetable matter.

SOWBUGS have a jointed OVAL body, two antennae. Some sowbugs can curl into a ball, their shell protecting their legs and gills, and are often called "pillbugs". Sometimes one that doesn't curl will be found to be a female carrying eggs in a brood sac formed by flat projections from her legs. The young resemble the adults; eat vegetable matter.

SCORPIONS are near relatives of spiders, have four pairs of legs, the front pair modified into pincers. The long, flexible abdomen ends with a poisoned stinger. They eat mostly insects and hunt at night, hiding under rocks or other dark places by day. After a long and elaborate mating ceremony, about 60 young are born alive and are carried on the mother's back for about a week.

REPTILES AND AMPHIBIANS

REPTILES Snakes, Lizards, Turtles, Alligators

AMPHIBIANS Frogs, Toads, Salamanders

The cold-blooded vertebrates (animals with backbones) fall into two main groups: REPTILES and AMPHIBIANS.

It is easy to tell to which group an animal belongs by the skin. The skin of reptiles is dry and scaly; the skin of amphibians is smooth and moist. Often people describe snakes as slimy....this is a mistake. Snakes, lizards, and turtles, being reptiles, are always dry unless dampened by rain or other water, and even then, they do not remain wet for long, as their scales do not hold moisture.

The skin of amphibians usually feels moist to the touch, but even they are never slimy. After handling a frog or salamander, there is no slime on ones hands; they are perfectly clean. Slimy is a term that describes fish, slugs, and snails, but never reptiles or amphibians.

Many people feel a great dislike for all cold-blooded creatures. This is probably because they are so unlike ourselves, but actually, most reptiles and amphibians are entirely harmless, and do a great deal of good.

All of the reptiles and amphibians that we have in Oregon are small. Their food consists of insects and other small animals such as mice, rats, slugs, frogs, and other creatures that have a very high reproduction rate, and therefore tend to overpopulate if left undisturbed.

Both reptiles and amphibians lay eggs, although some reptiles retain the eggs within the body of the female until they hatch, giving the effect of bearing the young alive. Young reptiles, when they hatch, look like their parents except for size. Reptiles lay their eggs on land, even those like the turtle and alligator which live in water, and the young must make their own way to water. Throughout their life, they are air breathers, and must come to the surface for oxygen.

Amphibians lay their eggs in water, and the young, when they hatch, are very unlike their parents. Usually they resemble small worms, they have no legs, and they breathe with gills, as fish do. Later they develop legs and lungs. At this time they either move entirely to land, or live in water, but must go to the surface to breathe. An example of this, that we have all seen, is the tadpole that becomes a frog. The tadpole lives in water, and breathes with gills. Later he develops legs and lungs, loses his tail, and becomes a frog. The young of amphibians eat algae, a plant scum that they scrape from plant stems and other submerged surfaces. Later they eat animal food, much as reptiles do.

As we travel about our Outdoor School study area we will observe the reptiles and amphibians, but we must not disturb them more than is necessary. Snakes, lizards, frogs, and salamanders each have their own home territories, just as you do. When we move them needlessly we release them into another's territory and this usually causes problems. How would you like to be dropped suddenly into downtown New York, Peking, or Cairo? A strange animal does not always find other animals ready to accept them, especially if food is short. Those creatures that we do hold in captivity for temporary study purposes should never be mistreated, and any animal that is taken for any reason should soon be returned to the area in which it was found.

Although one poisonous snake, the rattlesnake, is quite common in some parts of Oregon, it is not found at or near any of our Outdoor School sites. We have no poisonous snakes.

BIRDS

In temperate zones we always have birds, but not necessarily the same kinds of birds at all times of the year. Most of the birds that nest here in the spring and summer go south to spend the winter in a warmer climate, while the birds that nest farther north come to spend the winter with us. This movement is called MIGRATION, and the birds that move about in this way are called MIGRANTS, and are said to MIGRATE. Some birds that live in the high mountains move to lower elevations to avoid the heavy snows of winter.

Early in the spring the males of many kinds of small birds arrive in the nesting areas, each in search of a suitable place to raise a family. When the first arrival chooses his home, he decides how much space will be needed to provide enough food for his expected family; this determines the boundaries of his TERRITORY. He now selects one or more places to perch while loudly singing to announce to other birds of his species that this is his property, and trespassers will be prosecuted. Strange as it seems to us, other birds respect his rights and later arrivals choose other places. Soon the female birds arrive and begin their annual shopping around for mates. Just what determines the choice, whether it is personal attraction or possession of the better homesites, is not really known to us, but it is established that the males that arrive after the nesting sites have been occupied do not get mates, and so do not raise young. This is one of nature's ways of keeping the population of a species within the limits of available food. In an area where the food supply is great, the territories will be smaller, and so more birds will find homes. In years of very little food, the territories must be very large, making room for few nests.

If you attend Outdoor School during the spring session, one of your projects might be to locate the territory of a small bird, and try to establish its boundaries, as determined by his singing.

There is no such thing as a perfect home for all birds, as needs differ among species. As we change the use of land, we also change the habitat of the birds and the other animals. When we cut the trees we destroy the homes and food supply of the forest birds, but the grass and bushes that grow with the increased sunlight provide food and homes for other birds. When we clear away these bushes and grasses to plant crops on the land, we again destroy the homes and food supply of birds, but our fields supply still others. Even when we put buildings on the land, some kinds of birds, such as house-sparrows and pigeons will find a home, and will eat the cast-off scraps and the bugs that live with human habitation.

We can often tell what a bird eats by looking at its bill. Seed-eaters have strong bills for cracking seeds; many insect eaters have tiny sharp bills to enter crevises where bugs may be hiding; woodpeckers have strong, chisel-like bills to penetrate the bark of trees to reach the insects and worms working within; flesh-eaters such as hawks and owls have strong, hooked bills for tearing flesh. These are only a few of the many types of bills. When you see a bird, look at his bill and try to guess what he eats.

Through many generations, every part of the bodies of birds, as well as their habits, become adapted to their way of life. Feet will become webbed, or sharp talons develop through selective breeding. This simply means that the bird that is best fitted to live under these conditions will be a healthier specimen, and will have a better chance to reproduce than one not so well adapted. Therefore, the young, having a tendency to be like the parents, will gradually, through generations, become better equipped to meet the demands of their way of life.

We can find many examples of such adaptation. Birds that spend much time in the air hunting for their food, develop large, strong wings; birds that have no need to fly, as the ostrich, sometimes lose their wings altogether, or have such tiny weak wings that flight would not be possible. A few birds, such as the swift, spend so much time in the air that they have lost their ability to walk. Many water birds, excellent swimmers, and beautiful in the air, are so clumsy when walking that we have a special word "waddle", to express scorn for their appearance on land.

Birds that cannot escape from predators because of their bright colors, or because they are too slow, or too big and clumsy, or because they have no means of defending themselves, are soon eaten, and so have little chance to reproduce. In this way, nature slowly improves each species, or causes it to become extinct.

If you would like to become familiar with a few birds before attending Outdoor School, a good picture book, such as Marshall's "Familiar Birds Of Northwest Forests, Fields, and Gardens" or Peterson's "Field Guide To Western Birds" will give you the help that you need. The birds found at Outdoor School will vary with the season, and whether you are attending a site near farm land, or a river, or in a deep forest, the following birds will probably be found at all sites, both spring and fall:

Robin
Song Sparrow
Oregon Junco
Black-capped Chickadee
Chestnut-backed Chickadee
Rufous-sided Towhee
Assorted Warblers
Winter Wren
Rufous Hummingbird
Common Bushtit
Red-breasted Nuthatch
White-breasted Nuthatch
Brown Creeper
Woodpeckers
Steller's Jay
Common Crow
Turkey Vulture
Red-tailed Hawk
Great Horned Owl
Ruffed Grouse

MAMMALS

Mammals are the largest of all the animals living today, although most are not nearly as large as some of the reptiles that lived long ago. When you see an animal it is easy to tell if it is a mammal, because all mammals have hair, at least a few hairs, and no animals except mammals have true hair, although some have bristles that somewhat resemble hair, such as the short fibers on some caterpillars. Mammals are warm-blooded vertebrates, bear their young alive, and are the only animals that feed their young on milk.

It would be nice if we could simply walk out and see all of the mammals that live in our woods and fields, but it is not that easy. Mammals are intelligent creatures, and they do not trust people until it has been proven to them that those people are trustworthy. Most wild animals have little contact with man, and what contact they do have is often not at all reassuring to the animal, so animals that have been around people are often more timid than those that have never seen man. Deer are hunted for food and sport; the furbearing animals are killed for their skins; predators, even when the law forbids it, are often shot. Many children and irresponsible adults throw sticks and rocks at animals, or even kill them, for no reason whatever. It is no wonder that animals do not trust man.

When you walk through the woods, many animals are looking at you. Wild animals are camouflaged to escape detection by their enemies, including man, and they remain very still as long as they are aware that you are there. They are not dangerous unless they feel that you are a threat to them. If you would observe wild animals, sit very quietly, they will soon forget your presence and come out of their hiding places, but even then they may be very hard to see because of their protective coloring. This helps food species to elude predators, and helps predators to catch their prey.

HABITAT BARREL

All habitat or places where wildlife live can be likened to the old wooden barrel. Forests, meadows, ponds, deserts, streams, and oceans all must provide sufficient food, water, and shelter within their confines if animals are to survive. Likewise the barrel must have all three bands intact if it is to hold anything placed in it. Without all the bands the barrel would collapse.

In the spring and summer the pipeline of annual reproduction is open and nature tries to fill the barrel or the land around us with all the wildlife it is capable of holding. Not all creatures born or hatched stay in the habitat, however. Predators, diseases, accidents, and parasites are but a few of the "leaks" that cause them to disappear.

During some period of the year, usually winter, the amount or quality of these basic needs that is available shrinks and animal numbers must do likewise. In effect, the whole barrel shrinks. Wildlife in excess of the habitat's capacity die. Before nature takes its toll with starvation, exposure, or diseases, hunting seasons allow sportsmen to remove a portion of the surplus and help balance wildlife numbers with the capacity of the habitat. Nature eliminates the remaining surplus.

Seasons and bag limits determine when the sportsman faucet will operate and how much of the habitat's contents it will drain off. Surpluses removed by sportsmen are collected for fur, food, or other uses rather than allowed to flow out and be lost. Other leaks or decimating factors continue to reduce the level in the barrel long after the dribble the sportsman removes has ceased.

Finding ways to make the barrel bigger is a real chore for the wildlife manager. Stocking animals in an already full habitat is like adding more items to an already full barrel -- it doesn't work. Like the barrel, land and wa er have a limit to the number of wildlife they can hold. Any extras must go. Wildlife biologists attempt to increase or maintain the number of fish and animals around us by plugging the "leaks", finding new animals for unused sections of habitat, or by increasing the habitat or barrel's capacity. All these activities involve a manipulation of the basic needs for wildlife survival: food, water, and shelter.

Oregon Department of Fish and Wildlife

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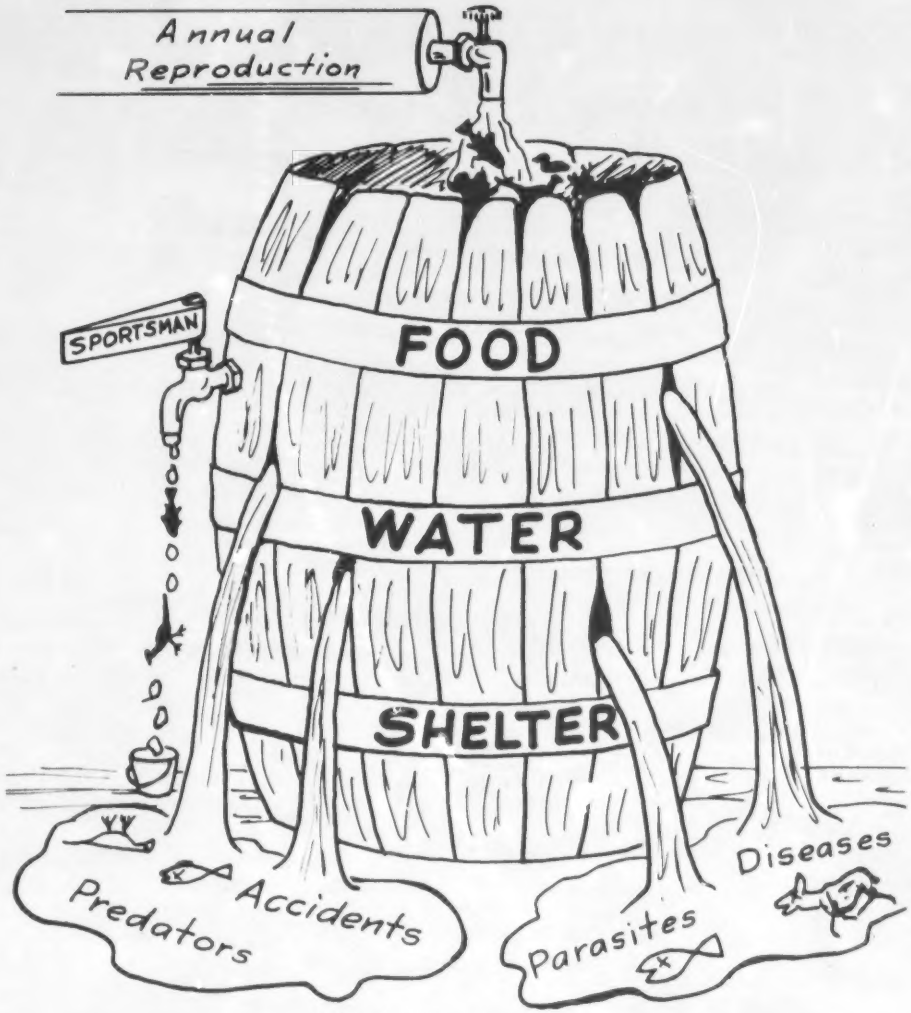

Habitat Barrel

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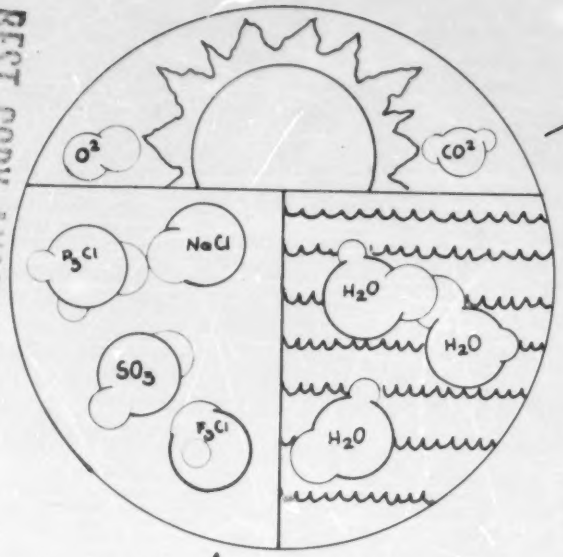
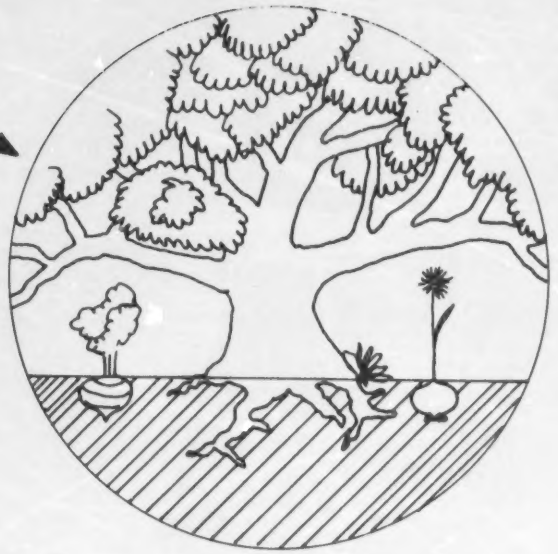
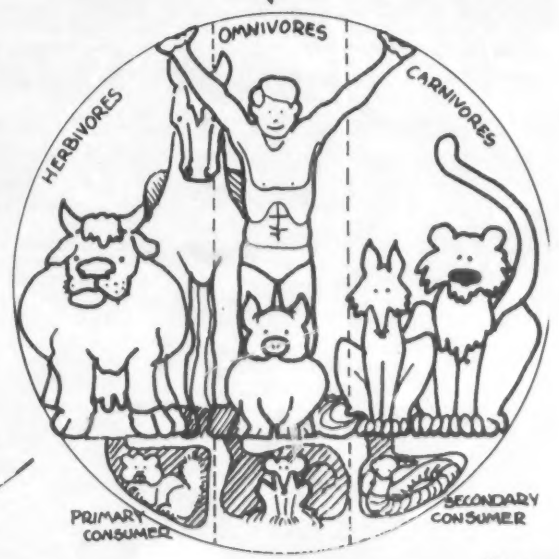
ECOSYSTEM



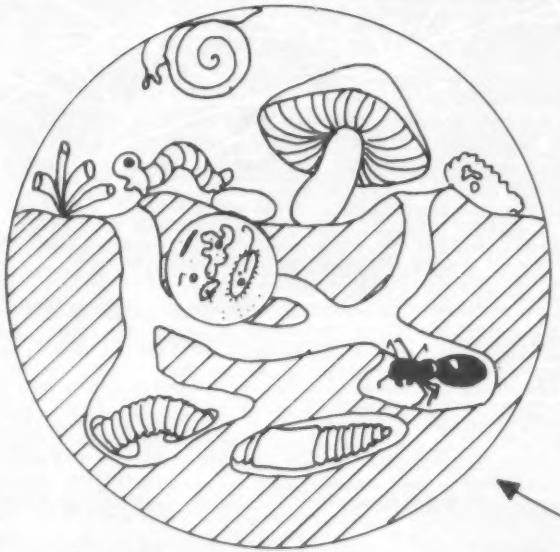
Non Living Matter



Producers



Consumers



Decomposers

An ecosystem is the sum total of all living and non-living parts supporting a chain of life within a selected area. The interaction of the four following links is critical in the functioning of an ecosystem. Any change in one link is bound to affect the others. This web-like relationship is the essence of the ecology of an area.

1. Non-living matter - The sunlight, water, oxygen, CO_2, soil with the organic compounds and mineral nutrients, used by plants for growth.

2. The Plants (Producers) - convert CO_2 and a water solution in a process called photosynthesis into organic compounds required both by themselves and other organisms in the ecosystem. Plants are our primary source of renewable wealth.

3. The Consumers - Higher organisms that feed on the Producers. Herbivores such as cows and sheep are primary consumers as are many insects. Carnivores, man and such animals as the coyote and lion feed upon herbivores and are the secondary Consumers. (Omnivores feed on both plants and animals.)

4. The Decomposers - Bacteria, fungi and insects close the system when they break down the dead Producers and Consumers and return their chemical compounds to the soil for re-use in plants.

UNSCRAMBLE THESE ANIMAL WORDS

Many of the words in the first column are from your "Terms Used In Animal Study" list. Write the correct word next to the scrambled word.

1.	DIPRES		
2.	LAMAMM		
3.	DEETPINCE		
4.	GLUS		
5.	RADLUIN		
6.	BIIPHAANM		
7.	RIDB		
8.	TISSEPAAR		
9.	MORTHWEAR		
10.	TIXOCE		
11.	TANNMUIR		
12.	AEIREBREVT		
13.	ROMOVSINUO		
14.	NECTIS		
15.	NOXSEOKEETL		
16.	TBITAAH		
17.	VTNAIE		
18.	TAUQCAI		
19.	LNUCNOTRA		
20.	BRAEHNITE		

ANIMALS YOU MAY SEE AT OUTDOOR SCHOOL

1.	ERED		
2.	NOCCAOR		
3.	OXF		
4.	OBB ATC		
5.	UKSNK		
6.	ALSWEE		
7.	TIBBAR		
8.	KUNMICHP		
9.	SLRQUERI		
10.	INOBR		
11.	AYJ		
12.	WCOR		
13.	NERW		
14.	PANTSAHE		
15.	WOL		
16.	WKAH		
17.	ISHYCRAF		
18.	OTURT		
19.	THOM		
20.	LOEM		

PROTECTION FROM ENEMIES

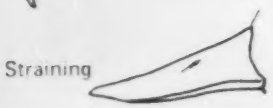
Some animals have developed special abilities or organs that they can use to protect themselves or their homes from enemies. Can you match the name of the animals with their means of defense?

1. _____	Skunk, Ants	A. Poison fangs
2. _____	Bees, Scorpions	B. Shell covering
3. _____	Rattlesnake	C. Antlers
4. _____	Snail, Crayfish	D. Quills
5. _____	Cow, Goat	E. Bad-smelling fluid
6. _____	Deer, Elk	F. Stingers
7. _____	Porcupine	G. Horns
8. _____	Coyote, Fox	H. Teeth
9. _____	Bob Cat	I. Talons
10. _____	Hawk	J. Sharp teeth and claws
11. _____	Hawk and Eagle	K. Speed
12. _____	Owl, Oppossum	L. Special digging claws
13. _____	Deer	M. Protective coloration
14. _____	Fawn, Hen Pheasant	N. Exceptional Eyesight
15. _____	Gopher, Mole	O. Nocturnal Habits
16. _____	Oppossum, Moth	P. Bluff, Feigning

ANIMAL ADAPTATION

Flesh eating

Ground Walking



Straining

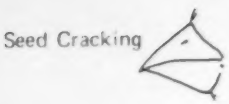
Tree Climbing

Insect Catching

Perching

"BIRD MIND—BOGGLER"

Draw the right beak and foot with each bird.

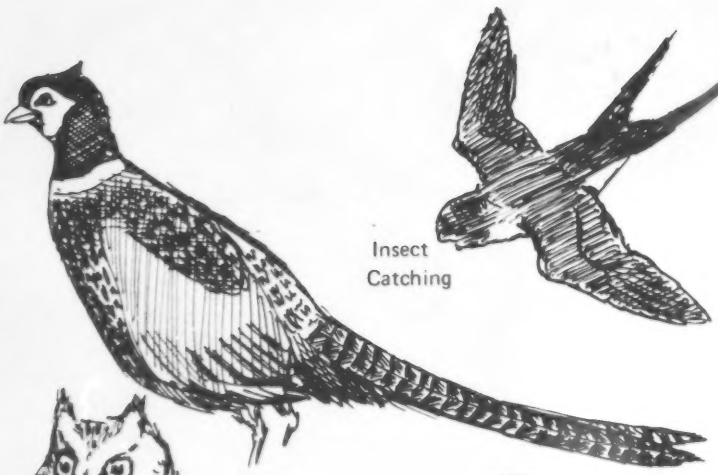


Seed Cracking

Grasping and Killing

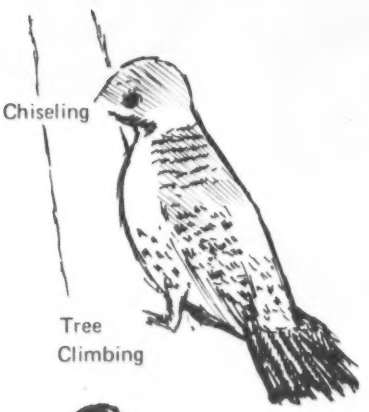
Chiseling

Swimming



Insect Catching

Ground Walking

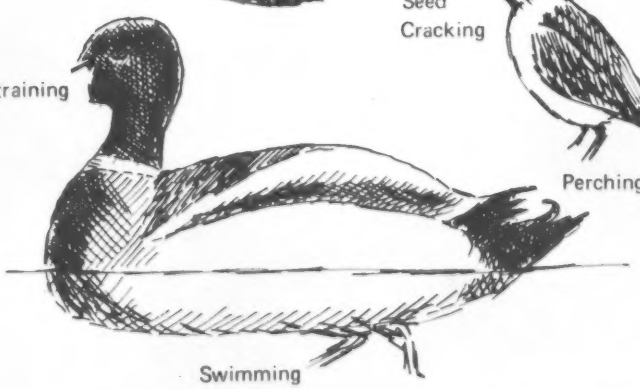


Chiseling

Tree Climbing

Flesh Eating

Grasping & Killing



Straining

Swimming

Seed Cracking

Perching

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KNOW YOUR WILD ANIMALS

Test yourself on your animal knowledge. Fill in the blanks using the names of animals that are found at Outdoor School. Most of these questions could have several correct answers.

1. An exotic animal that has become a pest in Oregon _____
2. A mammal that digs holes in the ground in which to live _____
3. A mammal that digs holes in which to store food _____
4. A mammal that never digs holes _____
5. A mammal that climbs trees to gather seeds for food _____
6. A mammal that climbs trees for shelter _____
7. A mammal that never climbs trees _____
8. A reptile that eats mice _____
9. A mammal that eats shrubs _____
10. A mammal that eats crayfish and fresh-water clams _____
11. A bird that eats insects from tree bark _____
12. A bird that eats dead and decaying animals _____
13. A bird that will eat almost anything _____
14. A bird that looks blue in bright light but black in shade _____
15. A bird that commonly lives in evergreen forests _____
16. A bird that kills many rats and mice _____
17. A mammal that walks on its toenails _____
18. An animal whose tracks look like a baby's handprint _____
19. An animal that has six legs _____
20. An animal that has eight legs _____
21. An animal with a smooth, moist, but not slimy skin _____
22. An animal with a dry, scaly skin _____
23. A four-legged animal that plants trees _____
24. A mammal that has become extinct in Oregon since the arrival of the explorers _____

To a person

UNINSTRUCTED

in natural
history,
his country
or seaside stroll
is
a walk
through a gallery
filled
with wonderful works
of art,
nine-tenths
of which have
their faces
turned
to the wall.

Thomas Huxley